DISSERTATION ON

Slipped Capital Femoral Epiphysis Treated by Subcapital Realignment of Epiphysis by Ganz Safe Surgical Dislocation – A Short Term Outcome Analysis

SUBMITTED TO

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for the award of the degree of

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CERTIFICATE

This is to certify that this dissertation titled **"Slipped Capital Femoral Epiphysis Treated by Subcapital Realignment of Epiphysis by Ganz Safe Surgical Dislocation - A Short Term Outcome Analysis"** is a bonafide record of work done by **Dr.Muthusubash. E.M.V,** during the period of his postgraduate study from June 2014 to June 2017 under guidance and supervision in the INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY**,** Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai-600003, in partial fulfillment of the requirement for M.S.ORTHOPAEDIC SURGERY degree examination of The Tamilnadu Dr. M.G.R. Medical University to be held in April 2017.

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DECLARATION

I declare that the dissertation entitled **"Slipped Capital Femoral Epiphysis Treated by Subcapital Realignment of Epiphysis by Ganz Safe Surgical Dislocation -A Short Term Outcome Analysis"** submitted by me for thedegree of M.S is the record work carried out by me during the period of **June 2014 to June 2017** under the guidance of **PROF.V.SINGARAVADIVELU, M.S.ORTHO., PhD.,** Professor of Orthopaedics, Institute of Orthopaedics and Traumatology, Madras Medical College, Chennai. This dissertation is submitted to The Tamilnadu Dr. M.G.R. Medical University, Chennai, in partial fulfillment of the University regulations for the award of degree of M.S.ORTHOPAEDICS (BRANCH-II) examination to be held in April 2017.

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Slipped Capital Femoral Epiphysis (SCFE) Treated by Subcapital Realignment of Epiphysis by Ganz Safe Surgical Dislocation – A Short Term Outcome Analysis

Contents

Slipped Capital Femoral Epiphysis

Introduction

Slipped capital femoral epiphysis (SCFE) is a common adolescent hip disorder . It is defined as a posterior and inferior slippage of the proximal femoral epiphysis relative to the metaphysis.

Any child with SCFE needs treatment. Untreated SCFE leads to chondrolysis, avascular necrosis and early degenerative arthritis. The principle of treatment in SCFE is attaining the biomechanical arc of motion of the hip.

According to Watson-Jones[1] (1962) "the treatment of displacement of upper femoral epiphysis is not a very happy chapter in the history of orthopaedic surgery". This is because of the difficult surgical procedures involved in correction of SCFE and the unfruitful outcomes of those procedures, which determine the long-term functional and social outcome in a child.

Surgical corrections in SCFE are aimed at the following factors:

1) Anatomical realignment of physis
2) Maintainence of blood supply to the physis
3) Prevention of recurrence of slippage

Slipped Capital Femoral Epiphysis

The major concern is the precarious blood supply to the femoral epiphysis. Thus a surgical procedure fulfilling all these needs is essential. This brought Ganz safe surgical dislocation of hip into limelight. This procedure gives credential to the vascular supply of femoral head at all stages. Ganz safe surgical dislocation made possible 360 degrees visualization of the acetabulum and the femoral head. This also helps in anatomical realignment of femoral epiphysis over the metaphysis.

Aims and Objectives

The objective of the present study is to analyse the patients with slipped capital femoral epiphysis (SCFE) treated by Ganz safe surgical dislocation and subcapital realignment of epiphysis and to assess the following:

1) Functional outcome
2) Radiological outcome
3) Complications of the surgical procedure

Slipped Capital Femoral Epiphysis

Incidence

Etiology

Pathogenesis

Types of SCFE

Femoroacetabular impingement

Diagnosis

Treatment options

Incidence

The overall incidence[2] of SCFE is 2 per lakh in general population.

78% of patients with SCFE are adolescents (10 -16 years of age) in the rapid growth phase[3].

SCFE occurs more frequently in obese children .

It is almost twice as common in boys as in girls.

It occurs approximately twice as often in black children as in white children.

The left hip is affected twice as often as the right.

Bilateral involvement is reported to occur in 25% to 40% of children[3]. When bilateral slips occur, the second slip usually occurs within 12 to 18 months of the initial slip.

Loder et al[4]. noted that SCFE can be idiopathic or atypical (associated with endocrine disorders ,renal failure and radiation therapy). They evaluated 433 children and found that children younger than 10 years of age or older than 16 years were 4.2 times more likely to have atypical SFCE and 8.4 times more likely if their weight was above the 95th percentile[3].

Etiology:

The cause of SCFE is mostly idiopathic[3]. It is also considered to be multifactorial in etiology.

Endocrine:

Cryptorchidism, Hypothyroidism, Hyperparathyroidism, Hypoestrogen states, Acromegaly, Adiposogenital syndrome, Panhypopituitarism, Pituitary tumours

Genetic:

Klinefelter's syndrome, Down's syndrome, Marfan's disease

Iatrogenic:

Secondary to medical interventions like Radiation therapy, Chemotherapy, Growth hormone therapy

Metabolic:

Rickets, Renal Osteodystrophy

Theories[5] of SCFE:

1) During a period of rapid growth in adolescence, weakening of the upper femoral physis and shearing stress from excessive body weight may cause the femoral capital epiphysis to displace from its normal position relative to the femoral neck. The shear stress actually occurs in the hypertrophic physeal zone.
2) Growth hormone stimulates growth of the physis, making it ready for the pubertal growth spurt. Sex hormones play a part in converting cartilage to bone. If the sex hormones fail to keep up, there is too much un-ossified cartilage unable to resist stress imposed by increased body weight.

Types of SCFE

Slipped capital femoral epiphysis may be classified [5,6] as:

Onset type:

Pre-slip : Widening of epiphyseal plate with no real slip, associated with weakness of the limb with exertion

Acute : Sudden onset, symptoms less than 3 weeks

Chronic : Symptoms greater than 3 weeks

Acute on Chronic : Symptoms for greater than 1 month with acute exacerbations

Loder's (functional) Classification

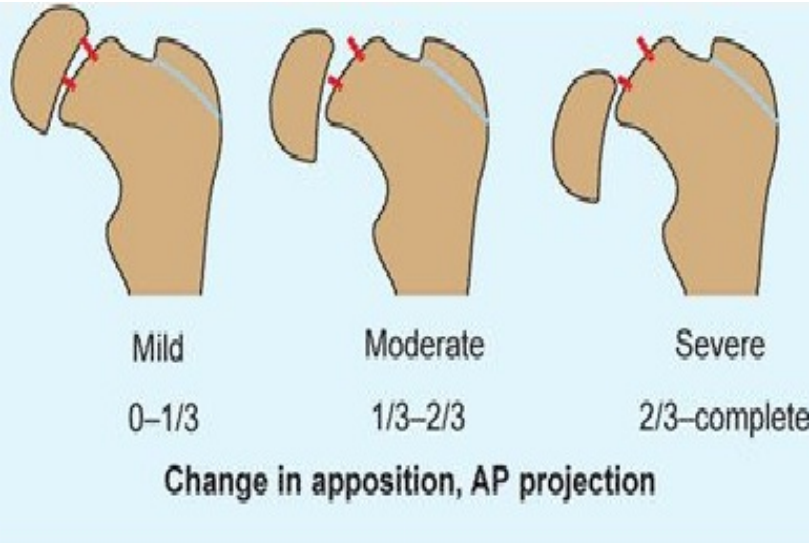
Stable: the child can walk and bear weight on the limb, with or without crutches

Unstable: the child cannot bear any weight on the limb , even with crutches.

Severity based on the slip

It is based on the proportion of epiphyseal displacement relative to the width of the metaphysis in the anteroposterior radiograph.

- **mild**: <33% (1/3 rd)
- **moderate**: 33-67% (1/3 - 2/3)
- **severe:** >67% (2/3 - complete)



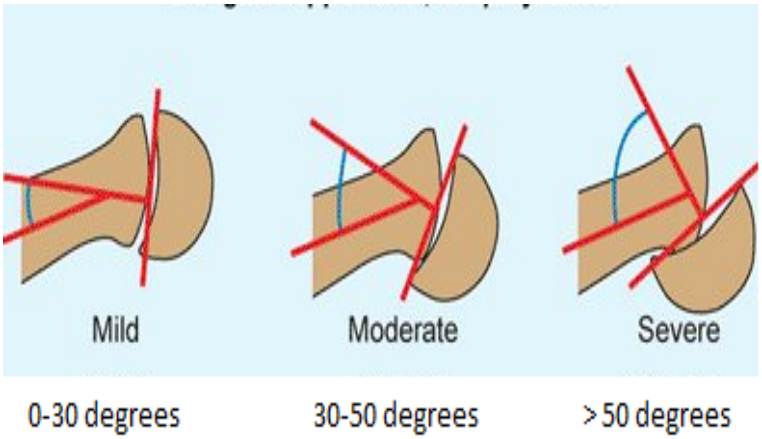
Southwick Slip Angle grading:

It quantifies the epiphyseal-shaft angle on the frog-leg lateral pelvis radiograph.

- **mild**: Less than 30˚ (~ 56%)
- **moderate**: 30 - 50˚(~ 25%)
- **severe**: Greater than 50˚ (~ 19%)

It is measured by the angle between a line drawn perpendicular to the baseline of femoral epiphysis and second line in the femoral shaft axis.

Then grading of slip is done by subtracting the ephiphyseal-shaft angle of the uninvolved side from the side with the slip.



In patients with bilateral involvement, 12 degrees is considered the normal value to subtract from each of the measured angles.

Pathogenesis

Grossly, with gradual slipping of the capital epiphysis in the typical posterior position, the periosteum is stripped from the anterior and inferior surface of the femoral neck. The area between the original femoral neck and the posterior periosteum fills with callus, which ossifies and becomes progressively more dense. The anterosuperior portion of the neck forms a “hump” or ridge of bone called Herndon’s hump[6] that can impinge (Cam type impingement) on the rim of the acetabulum. Normally, this ridge will remodel, with the anterior portion of the neck contouring into a smoother surface.

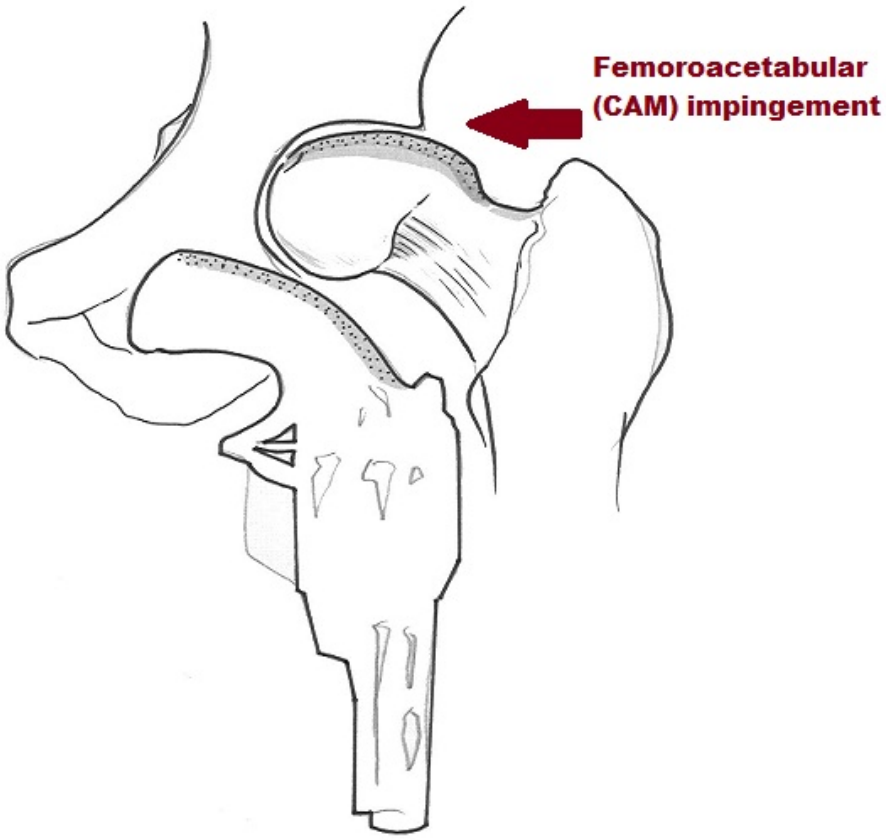
Femoro-acetabular impingement

Femoroacetabular impingement (FAI) is an increasingly recognized condition, which is believed to contribute to the premature degenerative changes of the hip occurring in SCFE. Slipped capital femoral epiphysis similar to an idiopathic pistol grip deformity[7] of the femoral head-neck junction can cause anterior impingement leading to pain, cartilage damage and eventual early degenerative arthritis.

Femoroacetabular impingement (FAI) in SCFE is an abutment conflict occurring between the proximal femur and the acetabular rim due to morphological abnormalities affecting the neck of femur. The

Herndon’s hump is the main cause of the impingement and cartilage damage.

Femoroacetabular impingement due to the anterosuperior hump (pistol-grip deformity)



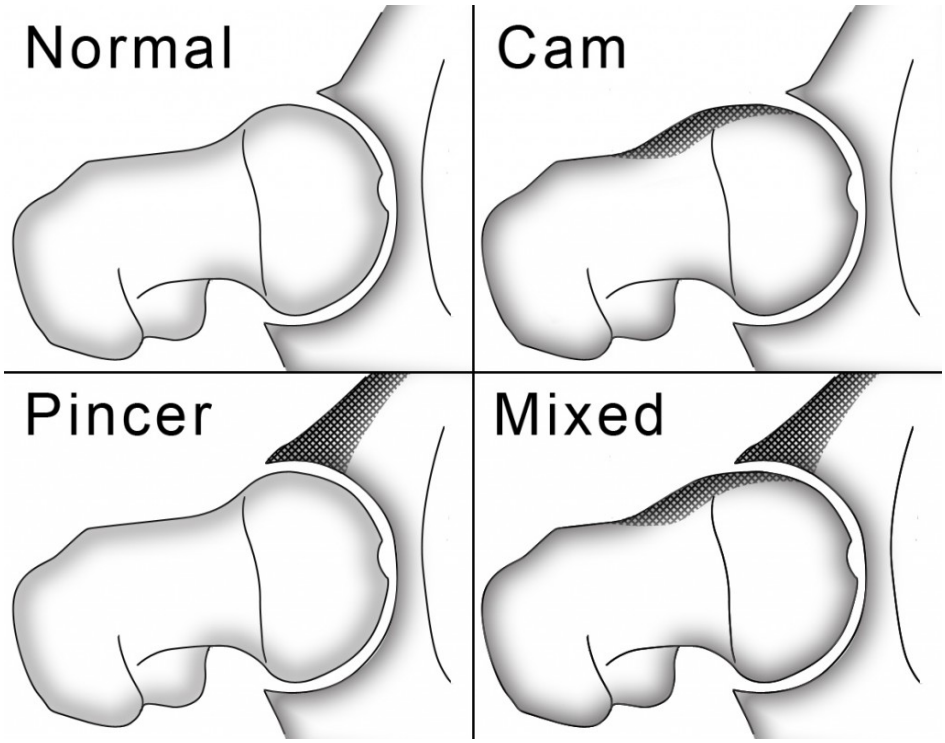
The repetitive mechanical conflict occurring between the femoral head and the acetabulum during motion, especially flexion and internal rotation can lead to damage of acetabular labrum and cartilage.

FAI can be divided into three subgroups based on anatomic deformities:

1) Cam impingement

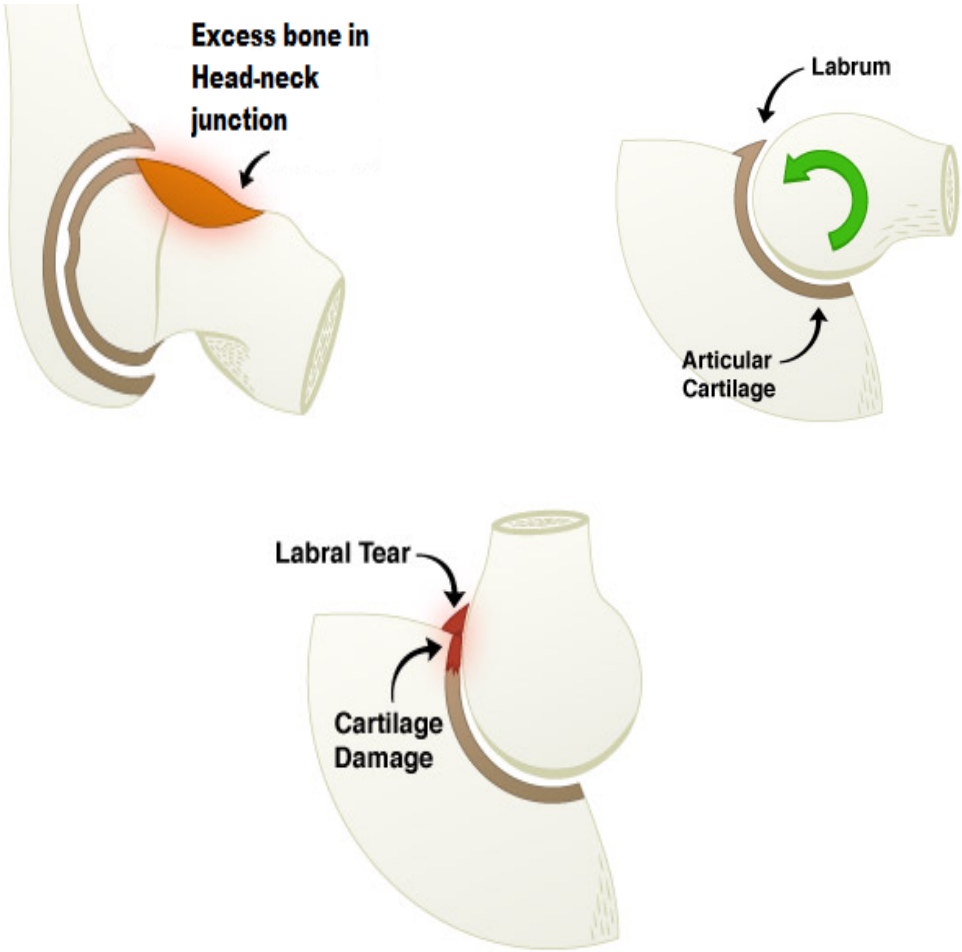
2) Pincer impingement

3) Mixed type



The pathogenic changes occuringin SCFE are due to the cam type of impingement[8]. The anatomy of the proximal femur is abnormal, such as a non-spherical femoral head or decreased head-neck offset. This leads

to forceful contact of the abnormal femoral head and neck with the opposing joint surface during activity. This force is most noticeable during motions that place the hip in extremes of flexion and internal rotation. The most frequent lesions both of labral tears and chondral injuries[9] noted with cam impingement are located in the anterosuperior aspect of the joint. The shear forces produce outside-in abrasion of the acetabular cartilage and its avulsion from the subchondral bone. Chondral avulsion in turn produces tear or detachment of the principally uninvolved labrum.



Cartilage Damage in SCFE

FAI in SCFE produces hip pain and decreased range of motion. These are temporarily treated by unsuccessful conservative measures. If surgically uncorrected this further leads to premature destruction of the joint.

Surgical treatment is focused on improved clearance for the hip motion and alleviation of femoral abutment against the acetabular rim. This is achieved by correction of the slip of the femoral neck with the removal of the Herndon's hump. Thereby , the normal arc of motion of the hip is established. Both these can be safely addressed by Ganz safe surgical dislocation method without affecting the blood supply to the femoral head.

Diagnosis

Commonly, an obese adolescent presents with pain over proximal thigh or more often over knee and limp.

Clinical features:

Antalgic gait

True supratrochanteric shortening

Fixed external rotation deformity or restricted internal rotation

Decreased abduction

Axis Deviation towards the ipsilateral shoulder

Decreased flexion and increased extension. This indicates there is change in arc of motion of the hip

Associated endocrinological features (obesity, absence of secondary sexual characters)

Radiological features:

X-ray:

Pre-slip:

On the anteroposterior view, widening and irregularity of the physis, rarefaction in the juxtaepiphyseal portion.

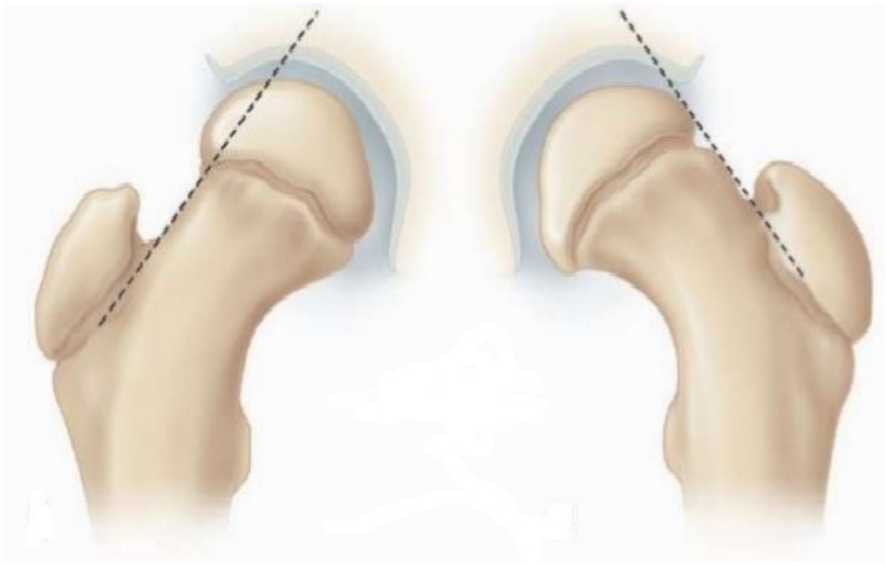
Slip:

Frog-leg lateral view of the hip is the most sensitive radiographic view for detecting a SCFE. It is taken with both the hips in full abduction and external rotation.

The following findings can be seen :

Klein's line (Trethowan’s sign):

It is the line drawn along the superior margin of the femoral neck in the anteroposterior radiograph. This line should intersect epiphysis. Usually in a normal hip 20% of the femoral head lies lateral to this line. In slipped capital femoral epiphysis , the femoral epiphysis is flush to this line or even below this line depending on the severity.

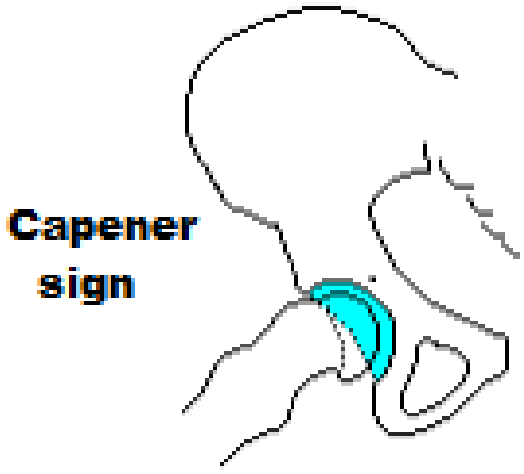


Klein’s Line

Epiphyseal-Shaft Angle (Southwick slip angle)

Capener's sign :

In pelvic AP view in the normal hip, the posterior acetabular margin cuts across the medial corner of the upper femoral metaphysis. With slipping, the entire metaphysis is lateral to the posterior acetabular margin.



MRI:

In a child with suspected SCFE and normal radiographs, MRI is useful in determining whether a pre-slip is present.

The MRI findings[10] are physeal widening, osseous edema adjacent to the physis, and the anatomic deformity associated with SCFE are typically seen. MRI is also useful in assessing whether osteonecrosis is present.

Treatment options:

The ideal treatment of SCFE should

1) prevent further slipping until the closure of physis
2) stimulate early physeal closure (epiphyseodesis)
3) avoid the complications of osteonecrosis, chondrolysis and osteoarthritis

Stabilization of the slip and closure of the physis are relatively easy to obtain by a variety of methods. However, prevention of complications has proved more difficult. This is due to the complex surgical techniques done for the SCFE correction which makes the vascularity of the femoral head at risk.

The above goals can be achieved by a variety of surgical procedures . The options available are the following:

(a) internal fixation (in-situ pinning)

(b) epiphysiodesis

(c) proximal femoral osteotomy

(d) spica cast immobilization

Spica cast immobilization and traction methods are not used nowadays because of their increased complications.

Meier and colleagues [11,12] noted complications in 14 of 17 hips managed with a spica cast for an average of 3 months. Complications included three pressure sores, further slipping in three hips, and chondrolysis in nine hips.

Proximal femoral osteotomies[2] are mostly done in children with closed physis. A wide spectrum of osteotomies at all levels have been described.

A) Subcapital

1) Dunn osteotomy

Anterosuperior cuneiform osteotomy done in lateral approach with trochanteric osteotomy

2) Fish osteotomy

Cuneiform osteotomy done in anterolateral approach without trochanteric osteotomy

B) Base of femoral neck

1. Kramer osteotomy (intracapsular)
2. Barmada osteotomy (extracapsular)

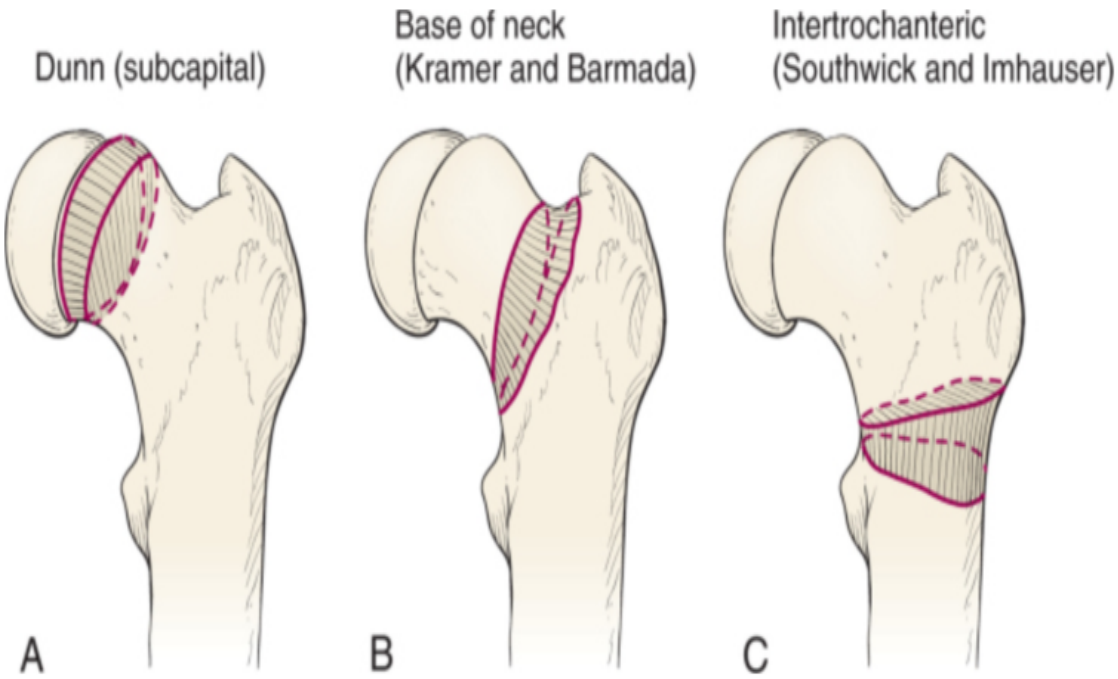
C) Intertrochanteric

1. Southwick (triplanar) osteotomy

   Corrects varus and posterior angulation primarily , internal rotation is added secondarily

2. Imhauser (biplanar) osteotomy

   Corrects posterior angulation primarily, external rotation and varus correction is added secondarily



Proximal femoral osteotomies have a high risk of compromising the vascularity of femoral head, the highest risk being with subcapital osteotomy. Additionally it is associated with limb-length-discrepancy. Even with attempts to preserve the blood supply, osteonecrosis[13] in up to 10% of cases and chondrolysis[14] in 2% to 10% has been reported following femoral neck osteotomy .

These drawbacks highlightened the importance of safe surgical dislocation of hip described by Ganz and its application in subcapital realignment of physis in SCFE. At no point of this approach, the blood supply to femur head is endangered.

Ganz safe surgical dislocation allows 360˚ visualization of femur head which aids in achieving:

- Anatomical reduction and subcapital realignment of physis , thereby biomechanics of the hip is achieved, which is of foremost importance
- Femoroacetabular impingement correction
- Preservation of blood supply
- Correction of limb length discrepancy

Ganz Safe Surgical Dislocation of Hip

The importance of Ganz surgical approach and blood supply to femur head are emphasized in the following statement of Crock et al[15] in his description of the detailed anatomy of the blood supply to the skeleton and spinal cord.

"theoretically a method is required by which the human hip joint can be dislocated atraumatically in the early phases of disease so that the blood supply of the upper end of the femur can be preserved"

Surgical dislocation of the hip is a complex procedure that is rarely undertaken. This is due to the potential danger to the vascularity of the femoral head, but there is little information as to how this danger can be avoided. Surgical hip dislocation can be carried out through an anterior, lateral or posterior approach.

Trueta and Harrison et al[15,16] showed that there is little or no blood supply to the femoral epiphysis from the lateral femoral circumflex artery, which Ganz et al have confirmed in their anatomical study.

Ganz et al[15] published their technique for safe surgical dislocation of the hip, based on detailed studies of the vascular anatomy of the hip.

Ganz's publication is based on his experience in 213 cases operated in seven years since 1992. In no case did avascular necrosis develop postoperatively.

Importance of Ganz approach:

The blood supply to the femoral head is mainly from the deep branch of the medial femoral circumflex artery (MFCA). This vessel is protected by the intact obturator externus[17] muscle during safe dislocation of the hip. Using a trochanteric flip approach[18] the hip can be exposed anteriorly, subluxated and dislocated while respecting the integrity of the external rotator muscles. This allows an interval of up to 11 cm between the femur head and the acetabulum, giving a 360° view of the femoral head and the acetabulum.

Using an anterior (Smith-Petersen) approach or a posterior approach, the femoral head can be dislocated safely, but inspection of the acetabulum is limited.

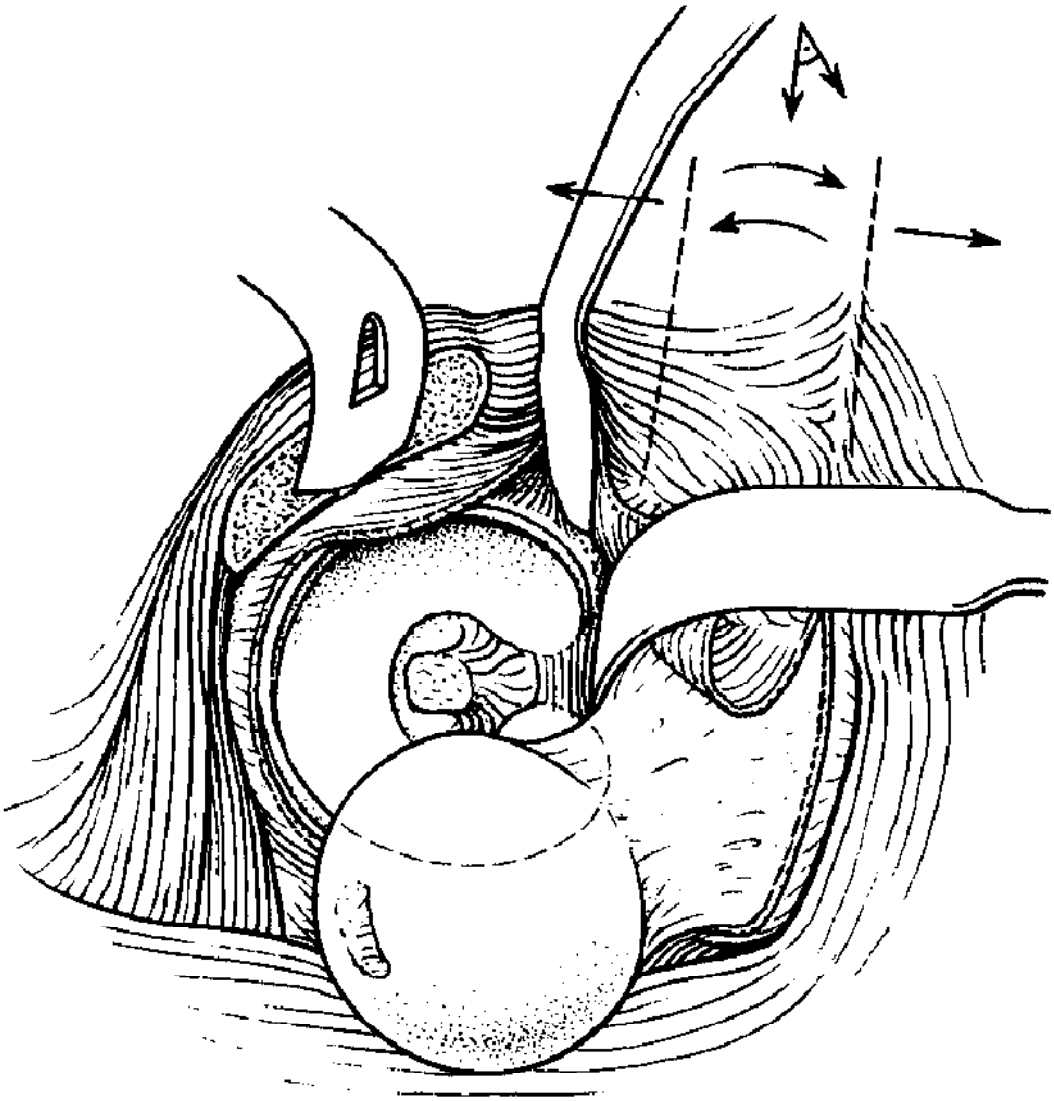
Safe surgical dislocation of the hip is useful for both the diagnosis and treatment of intracapsular pathology. Being familiar with this technique is reinforced when considering alternatives to this procedure.

The ability of the available imaging techniques[19,20] to diagnose acetabular labral damage and injury to the articular cartilage of the femoral head and acetabulum is currently limited.

360 Degrees Visualization of the Acetabulum and

the Entire Sphere of the Femoral Head by the

Safe Surgical Dislocation of the Hip



Hip arthroscopy[21,22] is used in the diagnosis and treatment of intra-articular pathology such as labral tears, loose bodies, and early osteoarthritis. But the technique is difficult and simultaneous assessment of movement of the hip and debridement is not possible.

Surgical dislocation helps in understanding the exact underlying pathology in these conditions. By surgically dislocating the hip using the Ganz technique, intra-articular surgery can be carried out safely, without the limitations and difficulties inherent in hip arthroscopy or arthrotomy without dislocation. Iatrogenic injury to the cartilaginous surfaces of the femoral head and acetabulum[23] can be minimised.

Vascular Anatomy and its surgical importance

The core principle behind Ganz safe surgical dislocation of hip is protection of deep branch of MFCA[17] (medial femoral circumflex artery). This is the principal blood supply to the femur head. In posterior approaches to the hip and pelvis the short external rotators are often divided. This can damage the deep branch and interfere with perfusion of the head.

In July 2000, Ganz and colleagues[17] described the anatomy of the MFCA and its branches based on dissections of 24 hips in cadaveric

study. The anterior aspect of the extraosseous course of the MFCA has been described in detail ,but the portion of the MFCA most important to the hip surgeon is the peripheral extra capsular division of the deep branch, which can be damaged during a posterior approach.

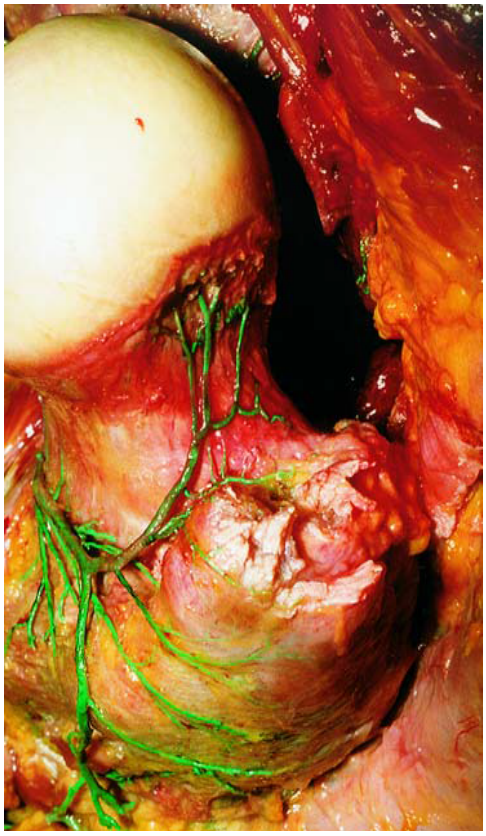
Therefore, a thorough anatomical knowledge about MFCA is essential to avoid iatrogenic avascular necrosis of the head of the femur.

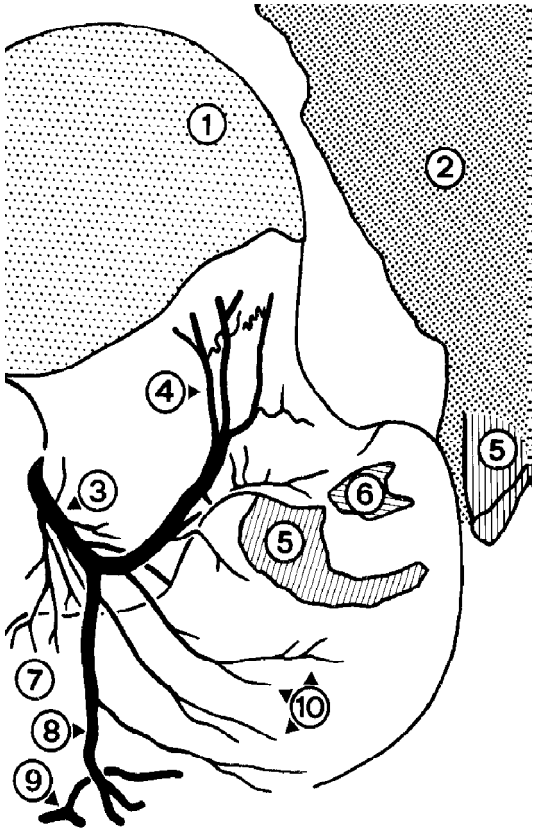
The MFCA originates commonly from the profunda femoris artery and occasionally from the common femoral artery. There are five consistent branches[24,25] of the MFCA.

S.No.	Branch	Path
1	Superficial	Courses between pectineus and Adductor longus
2	Ascending	To adductor brevis, adductor magnus And obturator externus
3	Acetabular	Gives off the foveolar artery (medial epiphyseal artery)
4	Descending	Courses between quadrates femoris and adductor magnus
5	Deep	To the head of the femur

MFCA constantly gives a trochanteric branch at the proximal border of quadratus femoris[26] spreading on to the lateral aspect of the greater trochanter. This branch marks the level of the tendon of obturatorexternus, which is crossed posteriorly by the deep branch of the MFCA. As the deep branch travels superiorly, it crosses anterior to the external rotators gemellus inferior, obturator internus and gemellus superior. It then perforates the joint capsule at the level of gemellus superior. In its intracapsular segment it runs along the posterosuperior aspect of the neck of the femur dividing into two to four subsynovial retinacular (superior and inferior) vessels.

The femoral head can be completely perfused by the superior retinacular vessels[26,27] alone. The medial epiphyseal artery usually perfuses only the perifoveolar area and rarely supplies a significant area of the head. Branches from the metaphyseal and lateral femoral circumflex arteries contribute very little to the vascularity of femur head. The anastomosis of lateral femoral circumflex over the femoral neck is seen only in young age[27](before the age of 4 years). Hence in adolescents and adults medial circumflex femoral artery with is branches are the most useful vessels for vascularity of the femoral head.

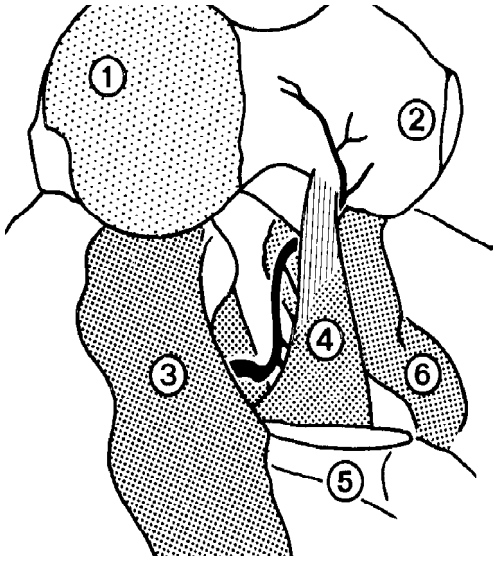




Photograph showing the perforation of the terminal branches into bone (right hip, posterosuperior view). The terminal subsynovial branches are located on the posterosuperior aspect of the neck of the femur and penetrate bone 2 to 4 mm lateral to the bone-cartilage junction.

1) the head of the femur 2) gluteus medius 3) the deep branch of the MFCA 4) the terminal subsynovial branches of the MFCA 5) insertion and tendon of gluteus medius 6) insertion of tendon of piriformis 7) the lesser trochanter with nutrient vessels 8) the trochanteric branch 9) the branch of the first perforating artery and 10) the trochanteric branches.

Anatomically, obturator externus protects the deep branch of the MFCA from being disrupted or stretched during dislocation of the hip in any direction.



Photograph showing the integrity of the deep branch of the MFCA during dislocation of the head of the femur (right hip, superior view). After complete dissection of the capsule and tendons of all external rotators, except for the tendon of obturator externus, The head of the femur is dislocated with external rotation of the femur. There is no stretch or compression of the deep branch of the MFCA during dislocation and the normal course of the vessel remains unchanged. Obturator externus tendon protects the MFCA

1) head of the femur 2) tip of the greater trochanter 3) rectus femoris ***4) obturator externus*** *5) acetabulum 6) quadrates femoris*

The increased risk to vascularity to the head of the femur can be explained by the terminal nature of the subsynovial branches of the MFCA and their exposed course along the neck. Necrosis of the head in SCFE occurs mainly due to the kinking[17] of the extraosseous vessels as a result of slipped epiphysis.

Bauer, Kerschbaumer and Poisel[28] reported iatrogenic damage to the MFCA even in intertrochanteric osteotomy, especially with osteotomy of the greater trochanter.

MFCA also has a vast anastomosis around the proximal femur. One such significant constant anastomosis is between the MFCA and a branch of the inferior gluteal artery along piriformis. This anastomosis may be capable of compensating after injury to the deep branch of the MFCA.

Advantages:

The Ganz method of surgical hip dislocation has several advantages.

1) 360˚ visualization of the femur head and the acetabulum
2) Preservation of blood supply to femur head
3) Anatomical reduction of physis

As the abductor is detached by trochanter flip osteotomy, rigid fixation of this flip fragment by screws restores immediate stability and allows for early mobilization of the patient. Moreover, by replacing this

fragment to a point other than the osteotomy site, a trochanter transfer effect can be achieved if necessary.

Countering hip arthroscopy in the management of hip diseases like femoroacetabular impingement, surgical dislocation of the hip joint allows full access to the acetabular labrum, the acetabular cartilage and the whole proximal aspect of the femur. It is currently well indicated for extensive femoroacetabular impingement or complex hip disorders as in this study. Surgical hip dislocation also enables more accurate contouring of the femoral head-neck junction and dynamic observation[29] of the impingement.

Technique[30] of Ganz Safe Surgical Dislocation and Subcapital Realignment of Epiphysis

In slipped capital femoral epiphyses (SCFE), severity of slippage results in poor long-term clinical outcome and radiographic evidence of osteoarthritis. Impingement in SCFE has been associated with damage of the acetabular cartilage, which may explain early onset of osteoarthritis after SCFE . This implies that, there is a potential role for realignment procedures that can safely restore the mechanical alignment and the femoral head-neck contour. Realignment procedures at the level of the deformity (ie, subcapital level) can result in anatomic or near anatomic restoration of the proximal femur.

The major complication is osteonecrosis, which is almost reciprocally proportional to the distance of correction from the physis , a phenomenon that can be explained by the vulnerability of the blood supply to the epiphysis as already described. Lenuig, Slongo and Ganz[30] described the subcapital realignment procedure by safe surgical dislocation of the hip. The rationale behind this technique is that the blood supply to the femoral head is preserved. This is a complex procedure that could be done only by experienced hip surgeons.

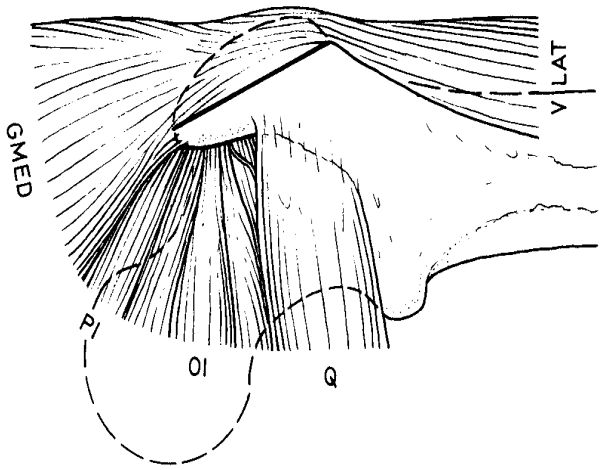
In the lateral decubitus position, we used Gibson posterolateral approach with posterior retraction of gluteus maximus. The skin incision

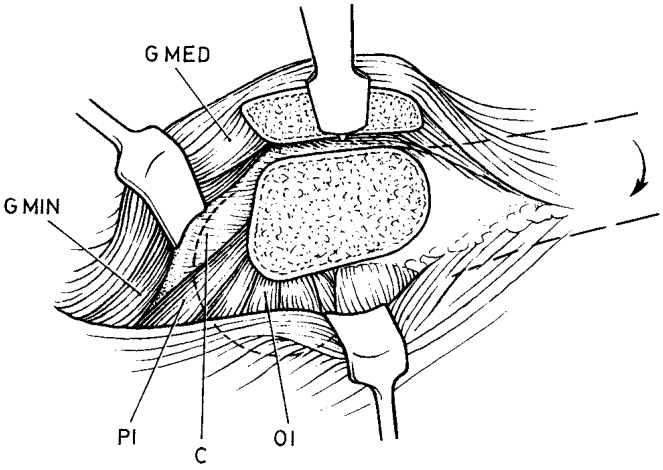
was made 6 to 8 cm anterior to posterior superior iliac spine(PSIS) and just below iliac crest to anterior edge of greater trochanter and extended distally along shaft of femur. The iliotibial band was cut from distal to proximal. The fascial layer between the gluteus maximus and medius is retracted along with the gluteus maximus to preserve optimal innervation and blood supply to the muscle.

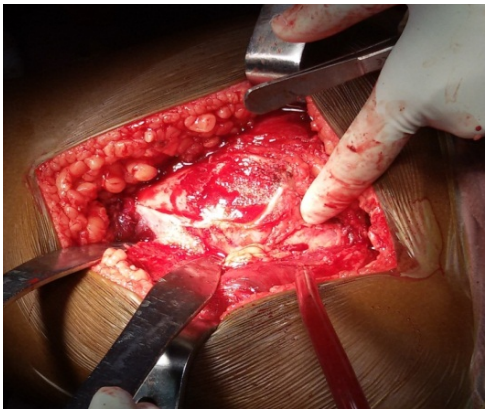
The leg is internally rotated and the posterior border of the gluteus medius is identified by dissecting the overlying adipose tissue. Proximally, this split is carried slightly posterior to the interval between the tensor fascia lata and the gluteus maximus (Gibson interval), in line with the direction of the gluteus maximus fibers.

The level and direction of the trochanteric osteotomy is then marked from the posterosuperior edge to the posterior border of the vastus lateralis. The osteotomy level should be anterior to the trochanteric crest to avoid injury to the insertion of the external rotators. At the maximum , the trochanteric fragment thickness should not exceed 1.5 cm and the osteotomy should exit proximally just anterior to the most posterior inserting fibers of the gluteus medius to keep most of the piriformis insertion on the femur and not on the fragment. The osteotomy along with its attached tendons was mobilized anteriorly.

Trochanteric Osteotomy







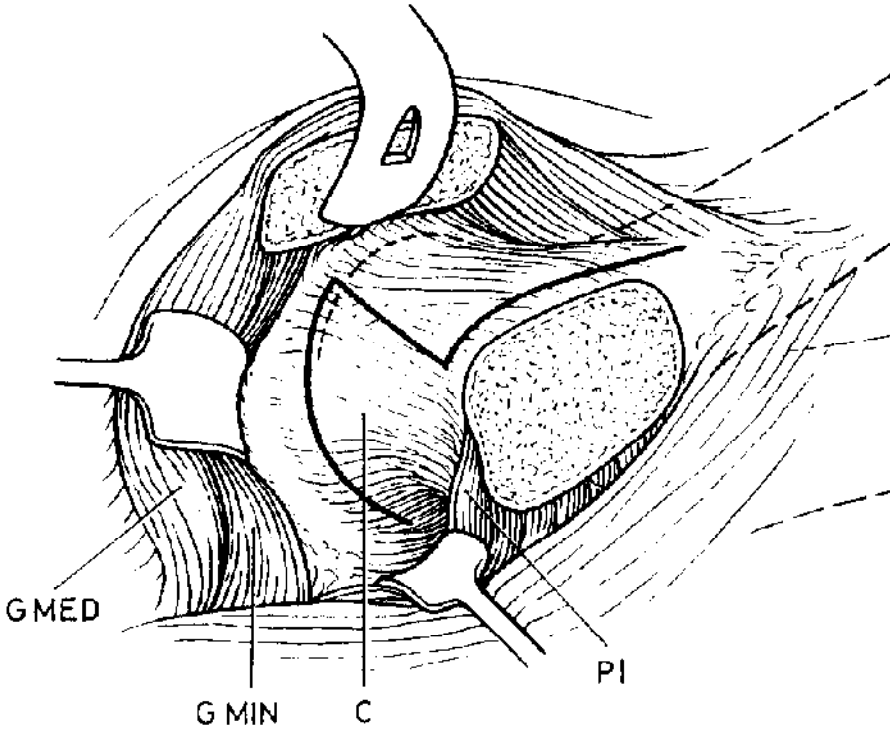
G MED- Gluteus medius, G MIN- Gluteus minimus

PI- Pyriformis, C-Capsule, OI- Obtruatorinternus

The anterior capsule is exposed by utilizing the interval between the piriformis tendon and gluteus minimus. This interval offers the best protection for the blood supply to the femoral head and allows preservation of the constant anastomosis between the inferior gluteal artery and the deep branch of the medial femoral circumflex artery. Then, the hip is flexed and externally rotated to increase exposure of the capsule in this safe interval. The gluteus minimus insertion over the anterosuperior part of the capsule is released while preserving the long tendon of the gluteus minimus that inserts anterior on the trochanteric fragment. Up to this stage of the procedure, all short external rotators remain attached to the stable trochanter and hence the medial femoral circumflex artery is protected.

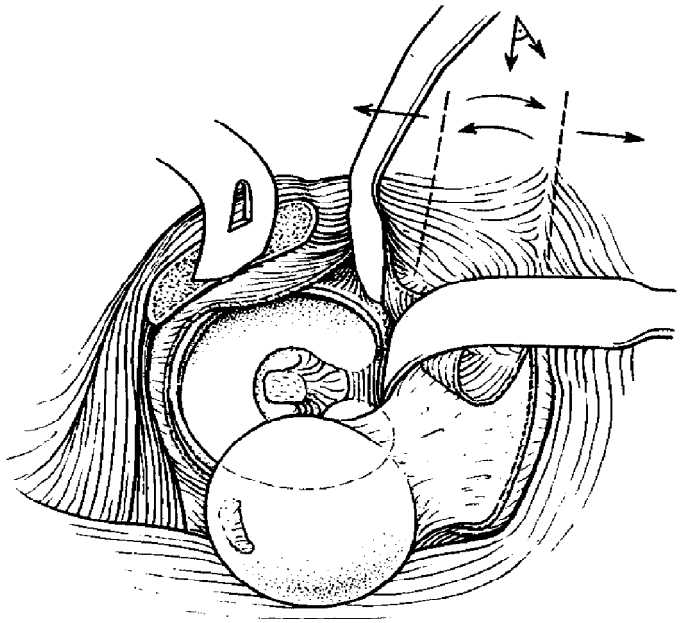
The capsule is incised close to the anterosuperior edge of the stable trochanter along long axis of the neck and perpendicular extension made along the anterior neck insertion to create a flap that can be lifted to create an inside-out capsulotomy that provides protection from cutting into cartilage and labrum. The Z-shaped capsulotomy[17] is extended along the posterior border of the acetabulum. The anteroinferior extension of the capsulotomy is directed towards the anteroinferior border of the acetabulum and must be anterior to the lesser trochanter to avoid damage to the main branch of the medial femoral circumflex artery, which is located just superior and posterior to the lesser trochanter.

Z- shapedCapsulotomy



G MED - Gluteus medius G MIN – Gluteus minimusC – Capsule PI – Pyriformis

Adequate Retractors Used to Visualise the Entire Hip



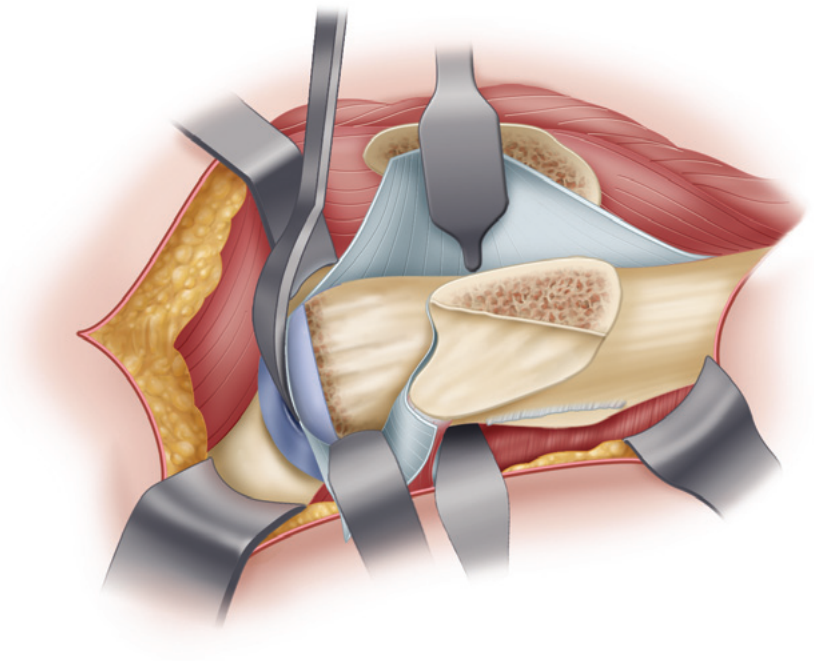
The anteromedial flap of capsule is retracted using a small spiked Hohmann retractor driven into the supraacetabular bone just lateral to the anterior inferior iliacspine. Additional Langenbeck retractors may be used for inspection of the joint for synovitis, quality of synovial fluid, degree of femoral head tilt and stability of the epiphysis on the metaphysis. If the epiphysis is mobile or stability is questionable, prophylactic pinning can be done. But, no attempt should be made at this time to reduce a mobile epiphysis anatomically, as there is a high risk of pathological stretching of the retinaculum before removal of the posterior callus.

Before surgical dislocation, a 2-mm drill hole is made in the femoral head to document vascular adequacy of the femur head .

Then, the hip is flexed and externally rotated and femoral head is subluxed, the round ligament is cut with a curved scissors. With retractors on the acetabular rim and teardrop area, the entire acetabulum (360 degrees) is inspected. Also the changes in the femoral head and the actual amount of epiphyseal slip are seen. The retinaculum protecting the terminal branches of the medial femoral circumflex artery to the femoral epiphysis is clearly visible on the posterosuperior contour of the femoral neck as a reasonably mobile layer of connective tissue. The femoral head cartilage should be constantly moistened during exposure.

The femoral head is reduced into the acetabulum. The area of the stable trochanter proximal to the visible physis is carefully mobilized and then excised subperiosteally in an inside-out fashion. The periosteum from the posterior neck is elevated with a knife and sharp periosteal elevator , taking care not to injure the anterior insertion of the retinaculum near the femoral epiphysis.

The anteromedial periosteum is released and extended distally upto the base of the lesser trochanter, and remaining stable trochanteric base. This creates a non-disrupted tube of periosteum from the epiphysis.



Periosteal tube created without vascular disruption

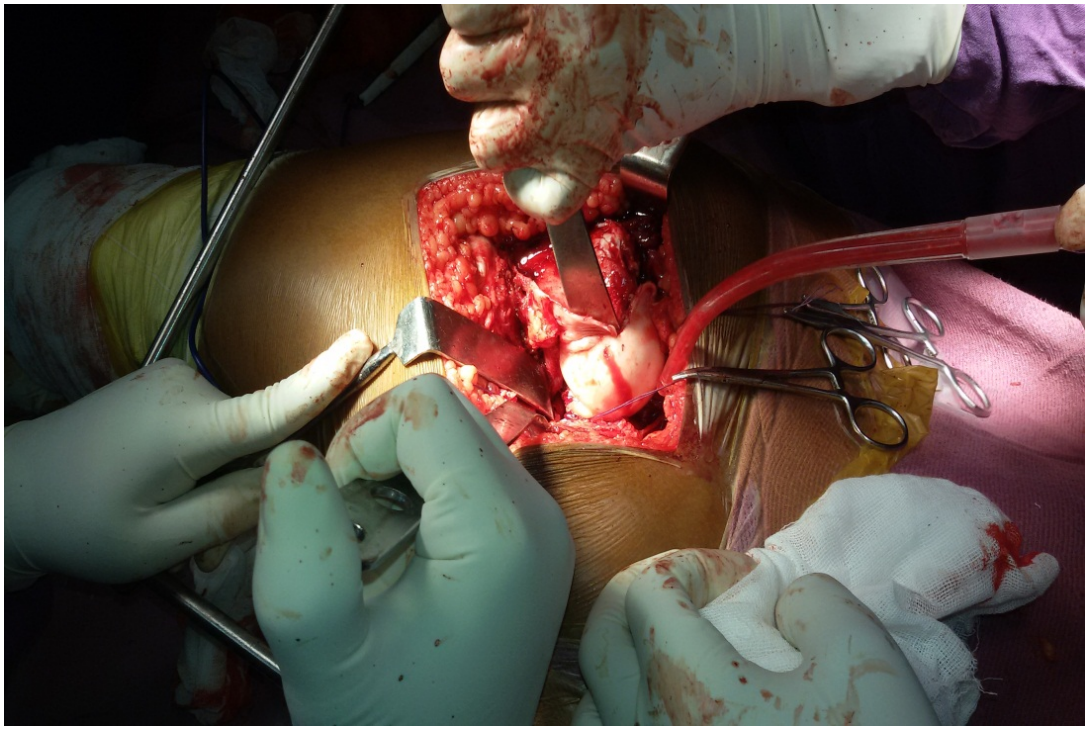
The femoral head is then dislocated by flexion and external rotation of the hip. The epiphysis is mobilized in a stepwise fashion with a curved 10-mm osteotome placed anteriorly into the physis. With simultaneous levering with the osteotome and controlled external rotation of the leg, the metaphyseal stump is delivered from the periosteal tube, while the epiphysis remains in the posteromedial position. The posteromedial callus bridge if present should be removed .

The isolated epiphysis may spontaneously reduce into the acetabulum at this time. Redislocation is difficult even with Kirschner wires inserted into the epiphysis. To avoid this complication, a small swab is placed in the acetabulum.

Remove callus formed on the posterior and posteromedial aspect of the neck and carefully trim the front surface of the metaphyseal stump. Use controlled rotational maneuvers of the shaped femoral neck to allow manual fixation of the epiphysis while curetting the remainder of the physis. Normally, the exposed epiphyseal bone shows clear bleeding as a sign of intact perfusion.

The epiphysis is reduced and temporarily fixed with a fully threaded Kirschner wire inserted in a retrograde direction through the fovea capitis, perforating the lateral cortex of the femur just distal to the vastuslateralis. This wire is pulled back so far that its tip is level with the articular head cartilage and reduce the head into the acetabulum. Then,

using this as a guide wire a single 6.5 mm cannulated cancellous screw is inserted.



Subcapital realignment with continuous bleed from the drill hole

The periosteal tube is closed with a few stitches, avoiding any tension. Close the capsule, also without any tension. The trochanteric osteotomy fragment is fixed with two 3.5-mm cortical screws.

Review of Literature

According to Howorth, Paré[31], should be given credit for the first description of SCFE as early as 1572, in Cinq Livres de Chirurgie, Paris . He describes SCFE as the condition in which “the epiphysis of the head of the femur sometimes becomes disjointed and separates in such a way that the surgeon is misled, thinking that it may be luxation and not separation of the epiphysis of this bone.”

In 1909, Whitman reported the first series of osteotomies for SCFE . In 1949, Boyd[33] reported the first stabilization of SCFE with pins . Kordelle et al. in their study have not found any difference in acetabular morphology in the affected and unaffected hips of children with SCFE . They explained that the lack of such acetabular differences is likely because SCFE generally occurs at an age at which little potential remains for acetabular remodeling.

Ganz and colleagues, in 2000, described the detailed anatomy of blood supply to the femoral head. They accounted the importance of medial femoral circumflex artery (MFCA) to the vascularity and its protection by intact obtruator externus.

The most renowned publication of Ganz et al, “ Surgical dislocation of the adult hip a technique with full access to the femoral

head and acetabulum without the risk of avascular necrosis ” in 2001 reported their experience using safe surgical dislocation approach in 213 hips over the course of seven years. They reported no cases of avascular necrosis in their study.

In 2008, Leunig M , Slongo T, Ganz R. in their article “Subcapital realignment in slipped capital femoral epiphysis: surgical hip dislocation and trimming of the stable trochanter to protect the perfusion of the epiphysis” described in detail their technique of safe surgical dislocation. They obtained excellent results with subcapital realignment of the slipped physis with no complication of avascular necrosis.

In 2003, Lavigne, Leunig and colleagues described the techniques of joint preserving surgeries. In 2006, Samantha spencer and Millis analysed retrospectively the early results of treatment for hip impingement syndrome in slipped capital femoral epiphysis and idiopathic pistol grip deformity of the femoral head-neck junction using the surgical dislocation technique. They found that osteoplasty done for SCFE has more better outcome than idiopathic pistol grip deformity.

Shin et al, in 2009, in their study credited Ganz surgical hip dislocation as an useful method in the management of several paediatric hip diseases, providing an unobstructed view of the femoral head and

acetabulum. In their series of 23 children with different hip diseases one case of avascular necrosis was reported.

In 2009, Kai Ziebarth and collegues showed that capital realignment using a modified Dunn procedure gave anatomical reduction of the physis. In their study on 40 hips, they used Kirshner wires for fixation of the physis. They encountered no avascular necrosis, but, three cases of delayed union of trochanteric osteotomy is reported.

In 2013, Jeremy and Anderson in their article in journal of paediatric orthopaedics analysed the role of subcapital correction osteotomy for malunited slipped capital femoral epiphysis resulting in pistol grip deformity. They reported 2 cases of avascular necrosis.

Materials and methods

A prospective and retrospective study was done in slipped capital femoral epiphysis patients operated in the Institute of Orthopaedics and Traumatology, Rajiv Gandhi Government General Hospital, Chennai. The eightpatients operated since November 2014 were prospectively and retrospectively analysed from November 2014 to August 2016. In this, the retrospective analysis was done from November 2014 to July 2016. The prospective analysis was done during August 2016.

8 patients (10 hips) with SCFE are operated by Ganz safe surgical dislocation and subcapital realignment of epiphysis. 6 patients had unilateral SCFE and 2 patients had bilateral SCFE.

Preoperative assessment of the patients done and Southwick's slip angle measured with the radiographs. At risk patients (obese and bilateral slip) are also investigated for any endocrinological abnormalities. Patients are classified according to the Southwick's slip angle into mild , moderate and severe slipped capital femoral epiphysis.

Inclusion Criteria:

- patients with chronic SCFE

- patients with moderate SCFE (Southwick's angle: 30 - 60 degrees) and severe SCFE (Southwick's angle: > 60 degrees)

- patients with open physis

Exclusion criteria:

- patients with acute SCFE

- patients with mild SCFE (Southwick's angle: <30 degrees)

- patients with closed physis

All 8 are male patients. All patients are in the age group of 10-16 years. All slips are of chronic type and moderate and severe type.

10 hips under study were operated by Ganz safe surgical dislocation and subcapital realignment of epiphysis with trimming of the overhanging trochanter done. The realigned epiphysis was fixed with a single 6.5 mm cannulated cancellous screw. The trochanteric osteotomy was fixed with two 3.5 mm cortical screws.

Postoperatively[3] passive hip mobilization was started on day one as tolerated by the patients. Assisted toe touch walking was started on

the third day. At 2 weeks patients are reviewed for any wound infection and sutures are removed. At 6-8 weeks, trochanteric union is seen and full weight bearing is allowed. Abductor strengthening exercises are added in the rehabilitation protocol.

All the patients were reviewed at 2 weeks, 6 weeks , 3 months ,6 months and further for functional outcomes, radiological outcomes and complications of the surgery. The followup was scheduled at these predetermined intervals mainly to assess:

1) 2 weeks - wound infection
2) 6 weeks - trochanteric union
3) 3 months - range of motion
4) 6 months - avascular necrosis changes

Functional Outcome:

The functional outcome of the patients is assessed by the improvement in the range of movements, particularly internal rotation, abduction and flexion. These are the movements most commonly affected in slipped capital femoral epiphysis due to the femoroacetabular impingement. The decrease in pain, which is the main symptom of the patients is also assessed.

Patients ability to perform his daily activities and social activites are also considered. The grading of the functional outcome is done by Harris Hip Score(HHS)[33].

Harris Hip Score(HHS) has 100 points which include,

1) pain (44 points)
2) function (47 points)
3) absence of deformity (4 points)
4) range of motion(5 points)

Score assessed after surgery:

1) Excellent - 90 to 100
2) Good - 80 to 89
3) Fair - 70 to 79
4) Poor - below 70

Radiological Outcome:

Anteroposterior and frog-leg lateral radiographs were taken to assess:

1) Correction of the Southwick slip angle
2) Recurrence of slippage
3) Trochanteric union

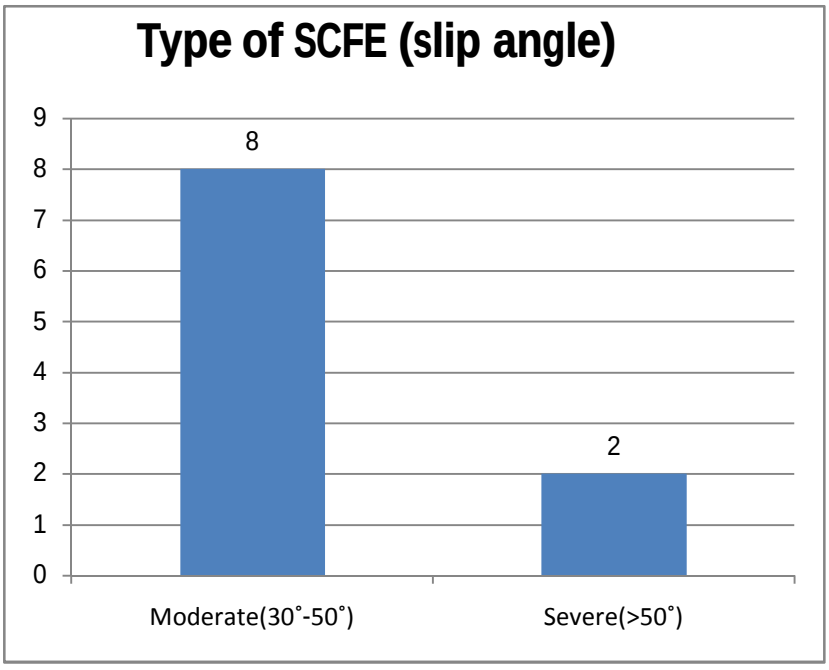
All the complications following the surgery like wound infection, trochanteric non-union, hardware related complications are assessed in all patients. But, the most dreaded and crippling complication of the surgical dislocation of hip, avascular necrosis is given particular importance in this study.

Observations and Results

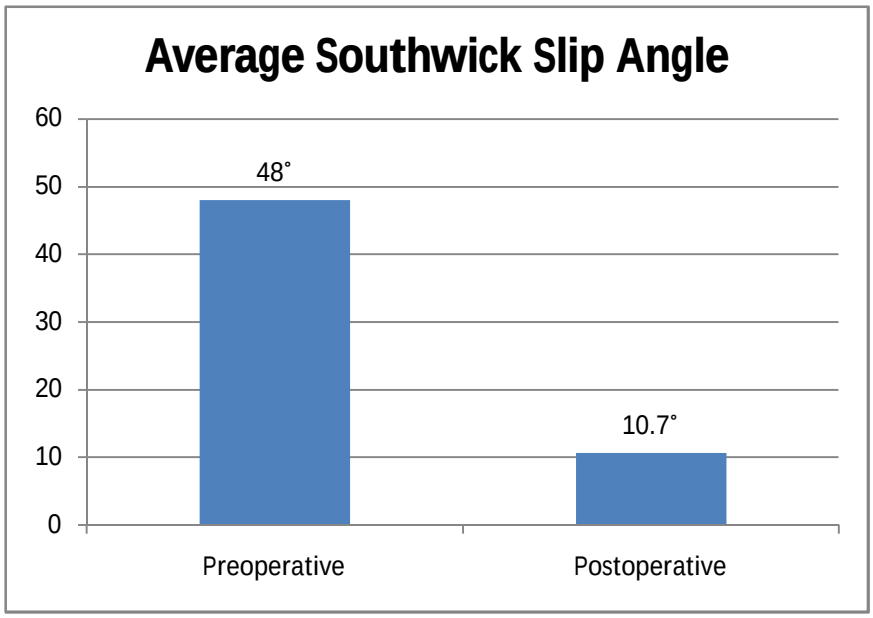
In our institute, 8 patients(10 hips) with moderate and severe SCFE were operated during November 2014 to August 2016.

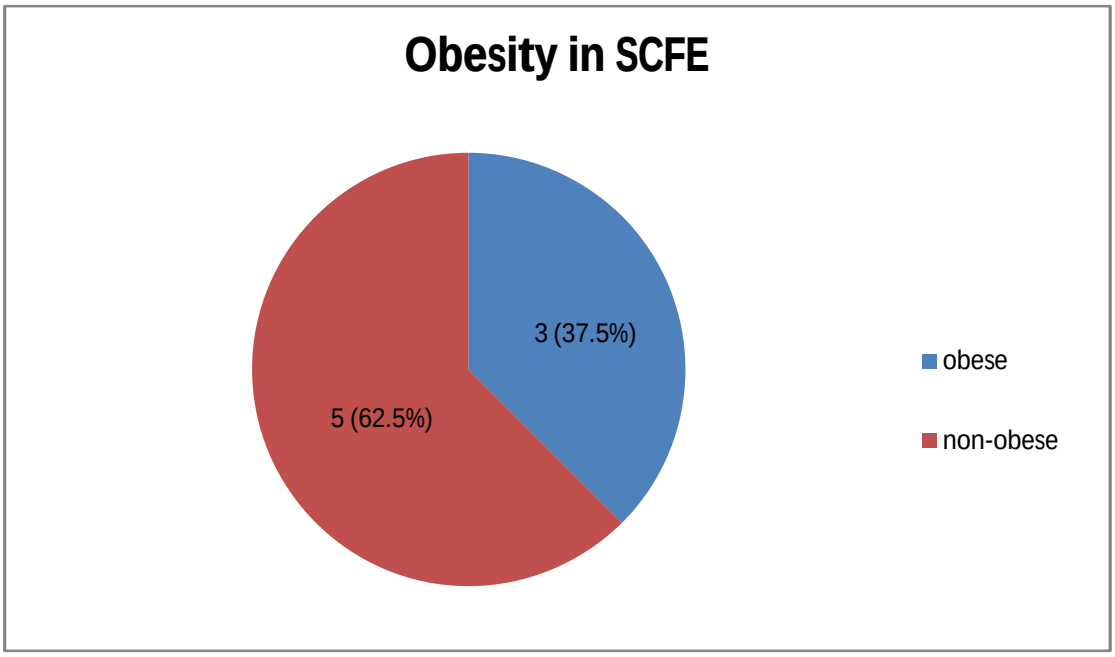
All the patients were in the age group of 10 – 16 years (average - 14 years). 3 patients (37.5 %) were obese. Among them bilateral involvement is seen in 2 patients (25 %). The duration of patients' clinical symptoms ranged from 3 weeks to 10 months (average duration of 10 weeks).

8 hips were of moderate slip type and 2 hips were of severe type. The degree of slip as graded by Southwick slip angle ranged from 40˚ to 70˚ (average slip of 48˚)

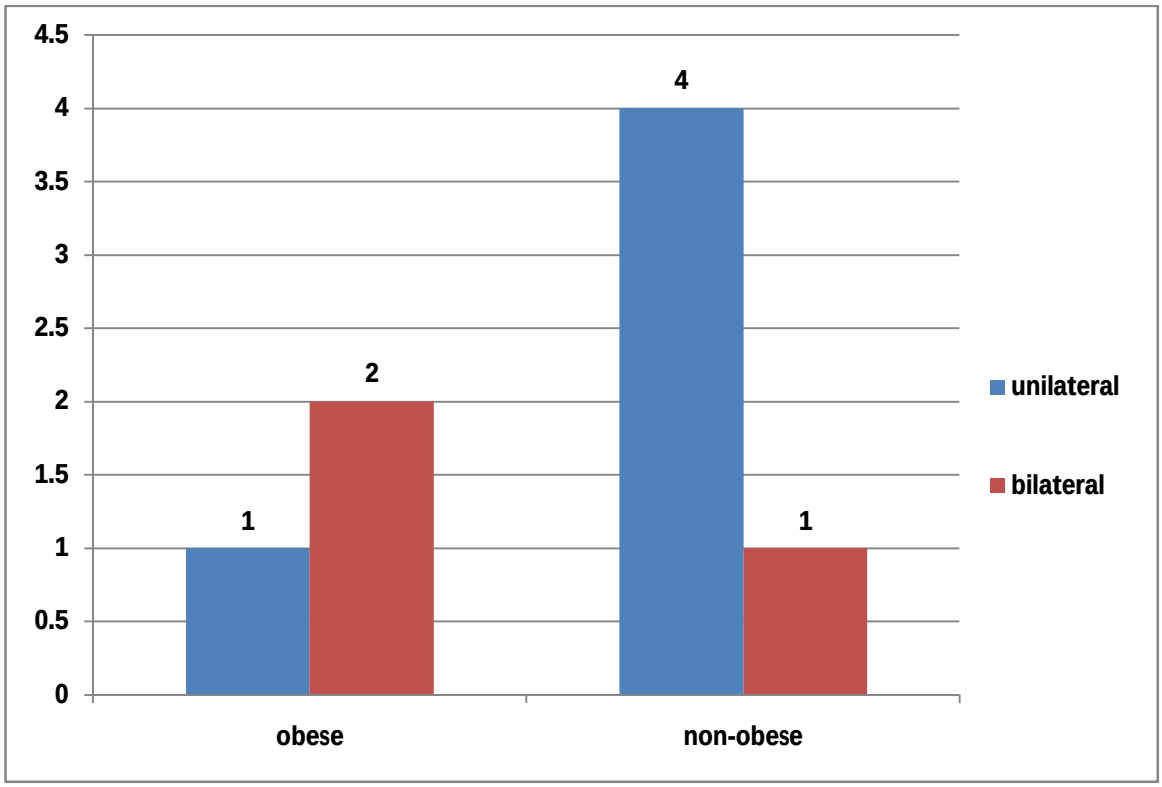


The anatomical realignment of the epiphysis led to a significantly beneficial correction of the slip angle ranging from 8˚ to 15˚ (average of 10.7˚).

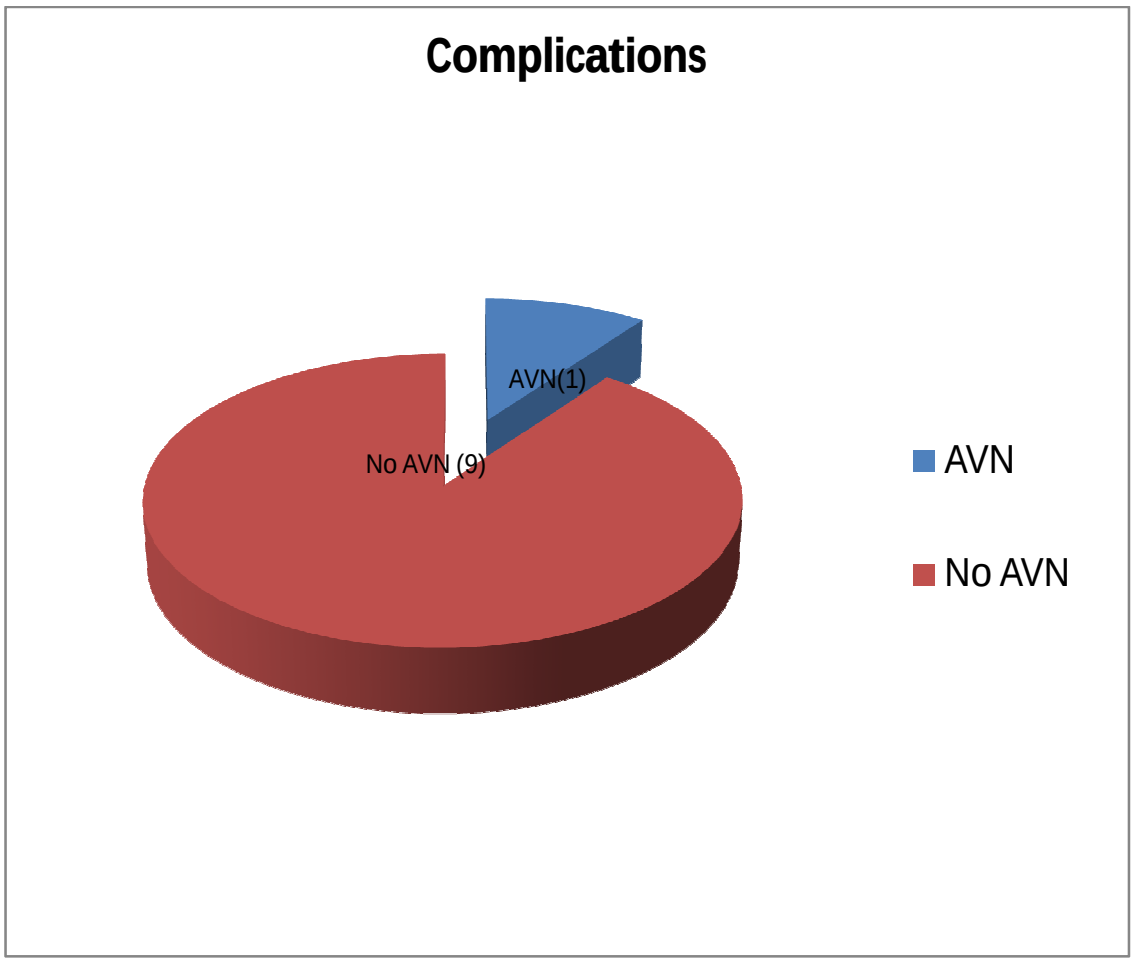




Bilaterality and obesity in SCFE



Follow-up ranged from 7 months to 16 months (average of 10 months). During the follow-up, no cases of wound infection was seen. 1 case of avascular necrosis occurred. In the same patient intraoperative drill hole bleeding was absent. At six months the patient had radiological changes of avascular necrosis. But symptomatically patient only had a mild limp. This patient alone had a fair outcome in Harris Hip Score. All the other patients in our study had good and excellent scores.



No cases of trochanteric non-union was reported. All trochanters united at 6 to 8 weeks with an average of 6.6 weeks. Full weight bearing was allowed in a gradual manner following trochanteric union and functional outcome was assessed. Abductor strengthening exercises were given. The normal abductor power was regained at 12 to 14 weeks.

The improvement in range of movements particularly internal rotation, abduction and flexion were assessed.

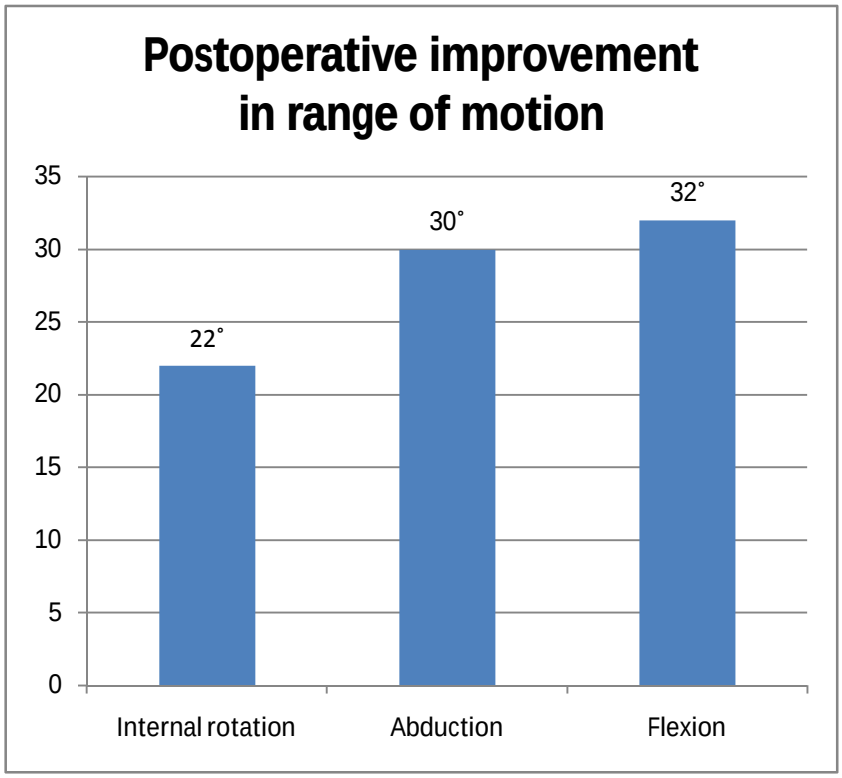
Patients showed improved range of movements as follows:

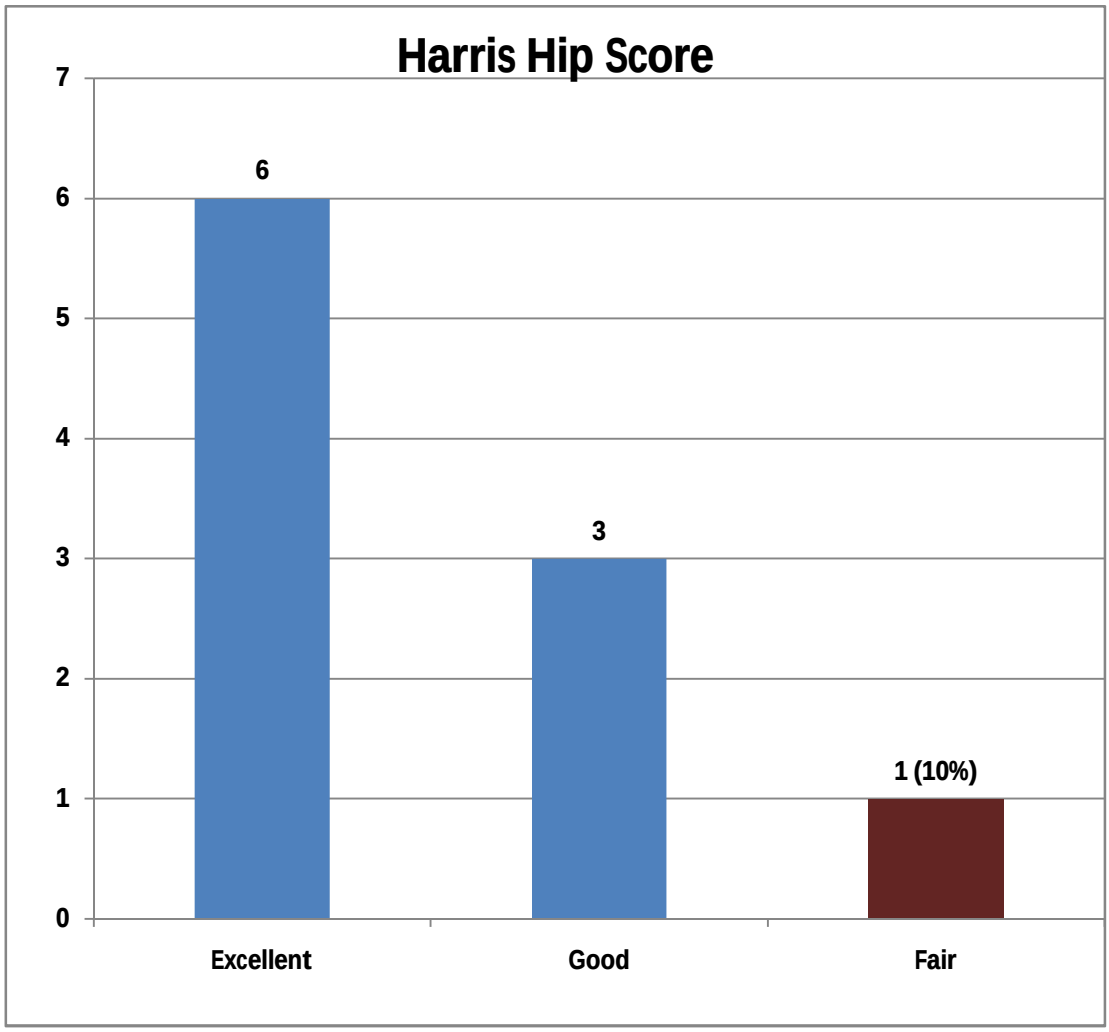
1) Internal rotation - 15˚ to 40˚(average of 22˚)

2) Abduction - 15˚ to 45˚(average of 30˚)

3) Flexion - 15˚ to 45˚ (average of 32˚)

The overall functional outcome is graded according to the Harris Hip Score(HHS). 7 out of 8 patients (87.5 %) had excellent and good outcomes in HHS. 1 patient had fair outcome. This patient developed osteonecrosis at the sixth month followup. Intraoperatively, bleeding from the drill hole was also absent.




Harris Hip Score
7
6
5
4
3
2
1
0
6
3
1 (10%)
Excellent
Good
Fair

Discussion

Even mild slipped capital femoral epiphysis leads to premature osteoarthritis resulting from femoroacetabular impingement[7]. Surgical methods aimed at correcting this have a high risk of osteonecrosis. Our study gives major consideration to anatomical realignment of the physis thereby, reducing the femoroacetabular impingement while maintaining the vascularity of the femoral head. The chance of avascular necrosis is also influenced by the mechanical instability of the slip.

In the procedure described in our study, both the vascularity of femur head and the mechanical instability of the physis are addressed. Intraoperative monitoring of perfusion of the femoral head is done by drilling holes both before dislocation and after reduction. Also, while realigning the physis using osteotome active bleeding from the undersurface of the epiphysis also indicates a viable head. Gill and Sledge[35] in their study on 44 hips found that among the 38 femoral heads with a bleeding drill hole 1 developed avascular necrosis (2.6%). All the 6 femoral heads without drill hole bleeding developed avascular necrosis. Although it may be argued that bleeding from a drill hole in the femoral head after dislocation does not exclude the possibility of subsequent avascular necrosis, a high correlation has been shown between this and

the presence of a viable head in a study on fractures of the femoral neck. According to Ganz et al , Laser Doppler flowmetry[36] has been found to be more useful for real time assessment of dynamic control of perfusion throughout the surgery. But this method is not followed in our study.

In our study, one case of avascular necrosis is reported. In this patient, at the time of surgery there was no bleeding visible after drilling the femoral head, even though retinacular vessels appeared intact. This indicated that the vascularity of the femoral head has been lost even before the surgical intervention itself. This patient developed osteonecrosis at 6 months. So, in our study we considered drill hole bleeding as a sensitive predictor of the vascularity of the femoral head.

Barring this single complication, excellent results have been obtained in our study with regards to functional outcome and slip recurrence. The normal Southwick angle (average 10.7˚) is attained in all the ten hips. Functionally, all the patients showed an excellent improvement in internal rotation, abduction and flexion of the hip, which are the movements primarily restricted in SCFE due to impingement. The development of premature arthritis due to femoroacetabular impingement is also averted. Yet long term studies are needed to assess the accurate decrease in incidence of the early arthritis.

In our study the following controversies in SCFE are addressed.

1) The number of screw placement
2) Postoperative weight bearing
3) When to do in-situ pinning
4) Prophylactic fixation of contralateral normal hip
5) Time for screw removal

In our institute, we used single 6.5 mm partially threaded cannulated cancellous screw for fixation. No cases of recurrence of slippage or epiphyseal perforation occurred. Percutaneous in-situ fixation was done in one patient with mild slip of the contralateral hip with mild symptoms.

Loder et al[37,38] in 2012 confirmed that in-situ pinning is useful in a chronic, stable and mild SCFE. Also, considering epiphyseal perforation and irritation with subsequent chondrolysis with multiple screws , use of single screw[39] gives satisfactory results.

Ganz et al[30], in his study of subcapital realignment in 30 hips fixed with two fully threaded Kirschner wires, reported failure in 3 hips. This is due the loss of correction caused by the bending of the Kirschner wires. In our study, we used a single 6.5 mm cannulaed cancellous screw for epiphyseal fixation. In none of our patients loss of the correction of the slip occurred.

Regarding postoperative weight bearing, there is a difference in opinions among surgeons - one group following a strict non-weight bearing for 16-20 weeks and the other group following early hip mobilization and weight bearing as tolerated.

In our study we followed a standard protocol for the 10 hips. Passive hip mobilization exercises are started on the immediate postoperative day and assisted toe touch walking is allowed from the third day. Weight bearing is allowed at 6-8 weeks on seeing the trochanteric union in the follow-up radiograph. No cases of recurrence of slippage or implant failure occurred.

According to Adam and Wilson et al[29], routine fixation of contralateral hip is not recommended. It can be done as a prophylactic measure only in at risk children:

1) young age at presentation
2) severe slip at presentation
3) non-specific obesity
4) children with endocrinological disorders
5) children on growth hormone therapy

In our institute prophylactic fixation of the other hip is not routinely done. Among the 10 patients, 2 obese patients had bilateral slip

and subcapital realignment is done on both sides. Other than this one patient had only obesity as his single risk factor and so, prophylactic fixation is not considered.

Some surgeons prefer routine screw removal[40] while others prefer it to be retained. According to the study by Ilchmann and Parsch et al in 2006, implant removal is not mandatory unless symptomatic. If at all done should not be before 1 year. In our study, screw removal is not done routinely and no patient had any hardware symptoms requiring screw removal.

Thus the surgical technique in our study achieved the goals of stable correction of position of epiphysis at the level of the tilt, undisturbed hip motion and prevention of further mechanical damage to the joint cartilage.

Limitations of this study :

There are a few limitations in this study

1) Small study group of 10 patients

2) Short term follow up

3) No comparison group

Case illustrations

Case 1

A 13 years obese boy with H/O limp (left side) for 2 months

- Left Hip - externally rotated
- Shortened left lower limb
- Quadriceps and Gluteal muscles wasting

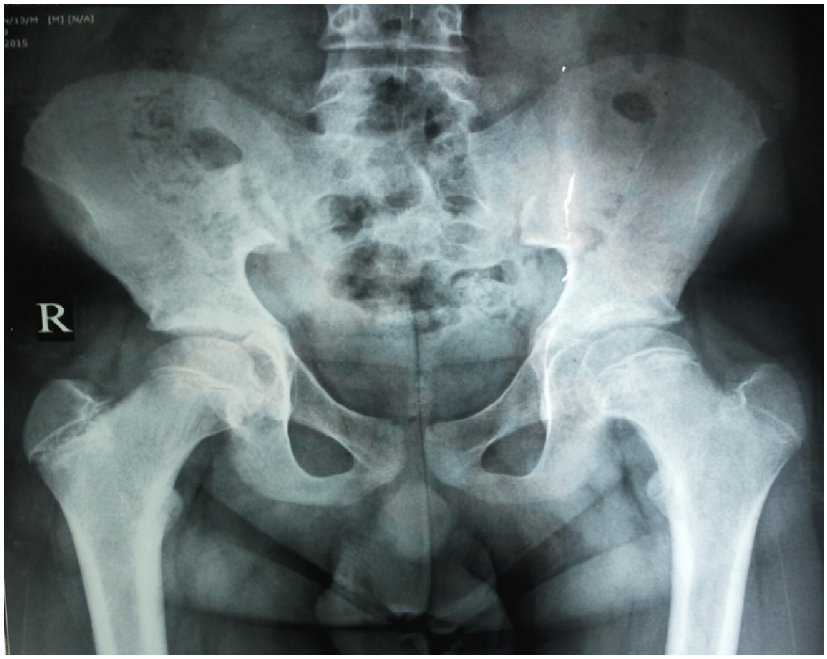
Axis deviation present

Hip movements are restricted – abduction and flexion are more restricted

Flexion 90˚/Axis deviation

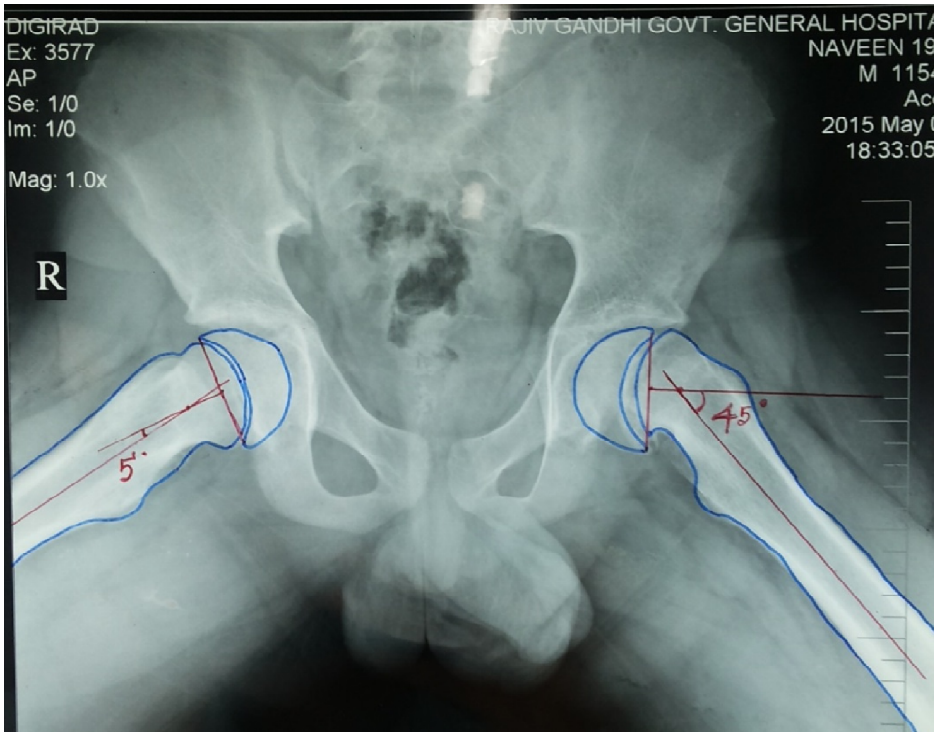
Extension 20˚

Anteroposterior view



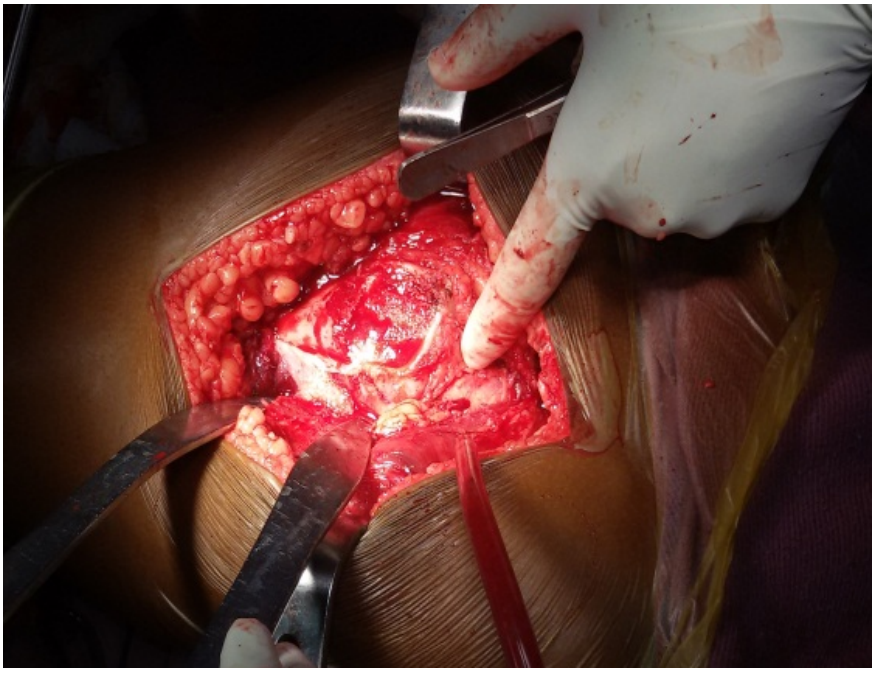
Frog-leg lateral view

Southwick slip angle - 45˚

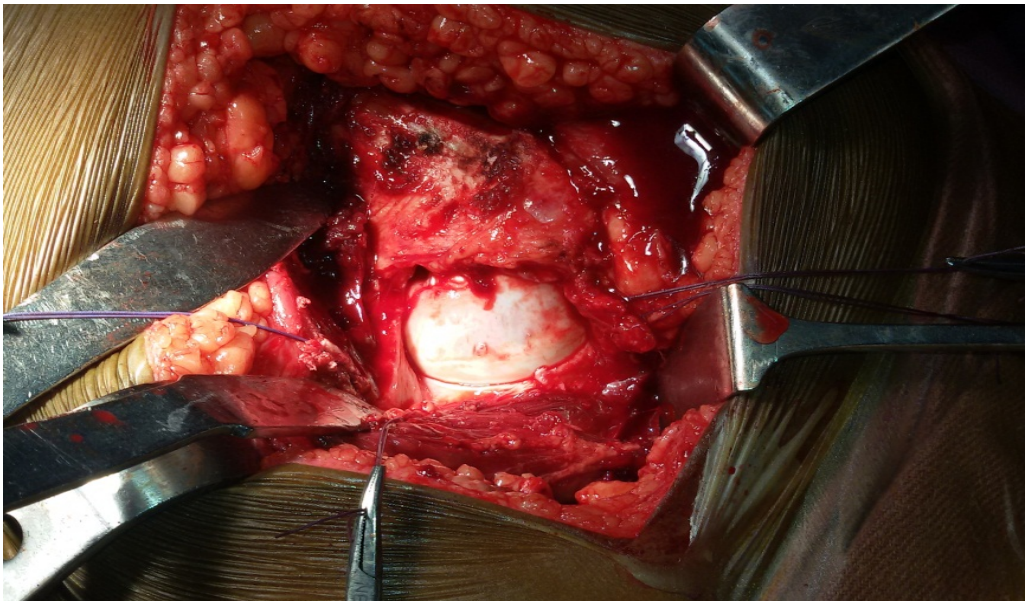


Intraoperative photographs

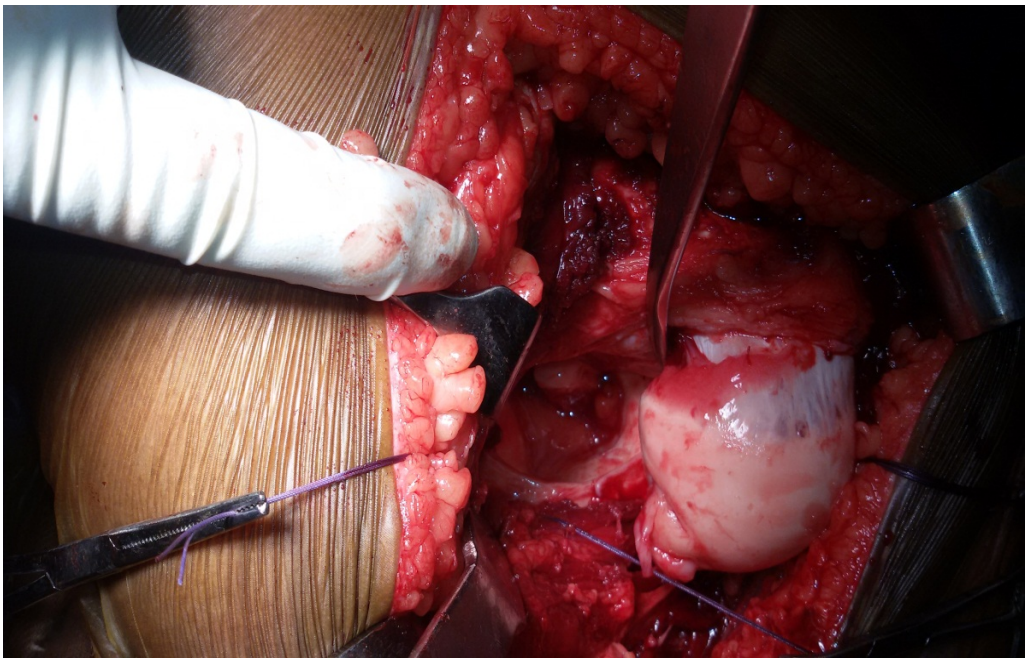
Trochanteric osteotomy



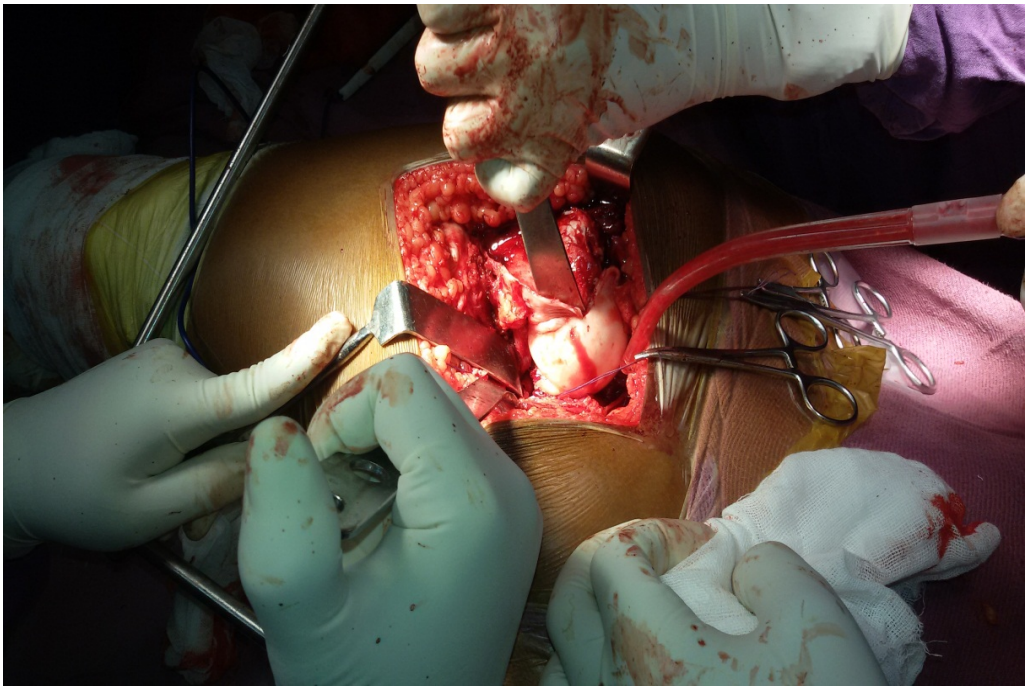
Trimming of stable trochanter

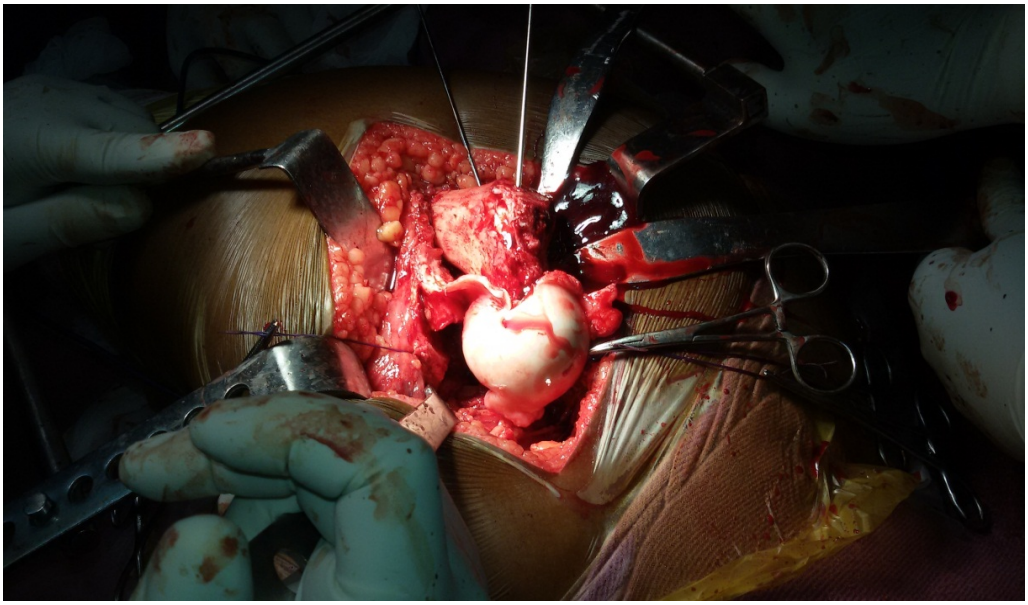


Dislocation of femur head

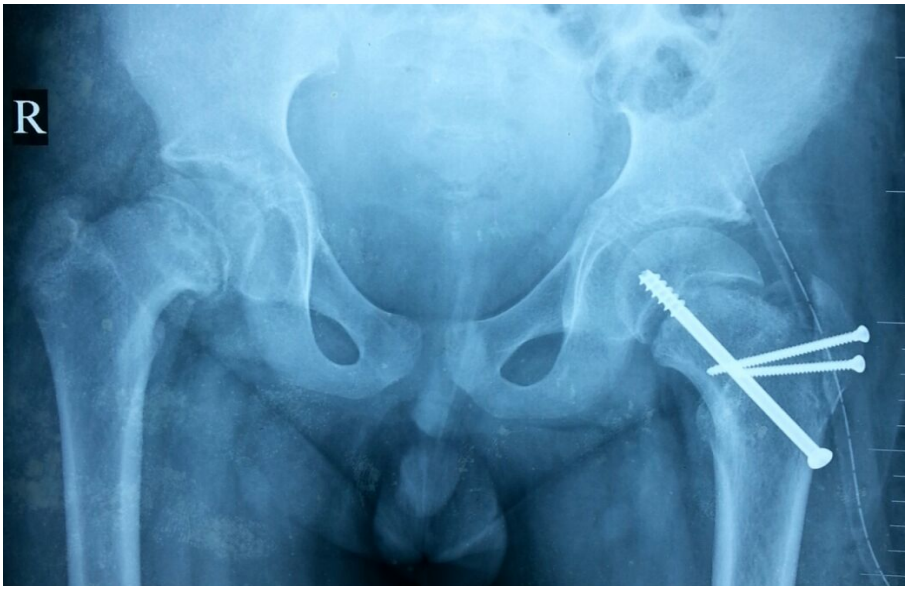


Subcapital realignment of physis and maintained vascularity(Bleed from drill hole)



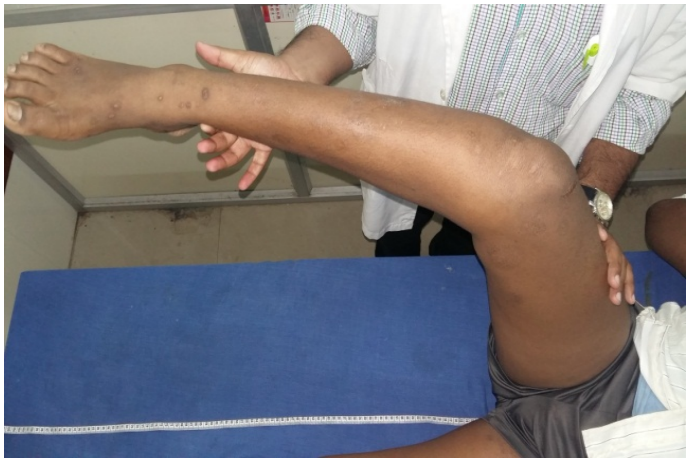


Post operative radiograph

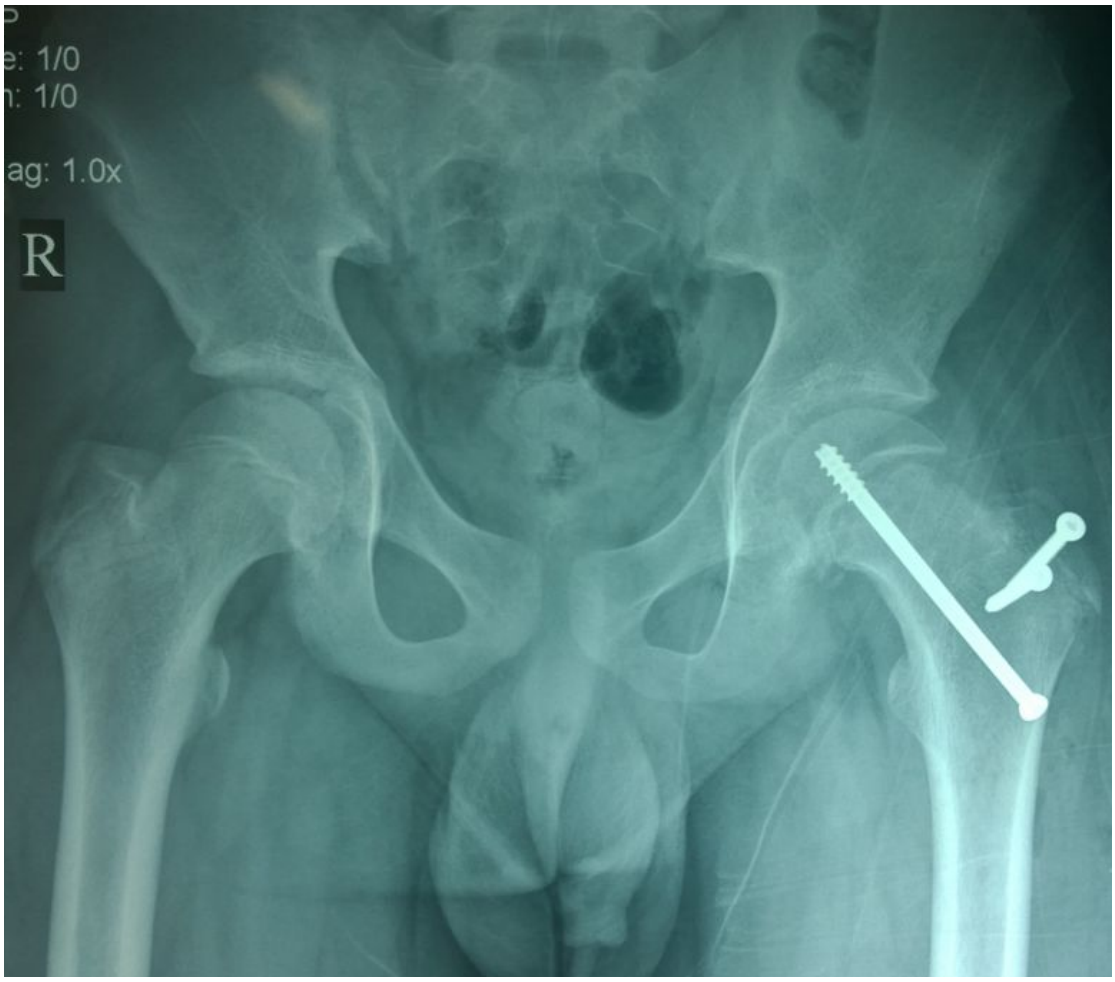


Postop abduction 60˚

Postop internal rotation 20˚



3 months post-op radiograph

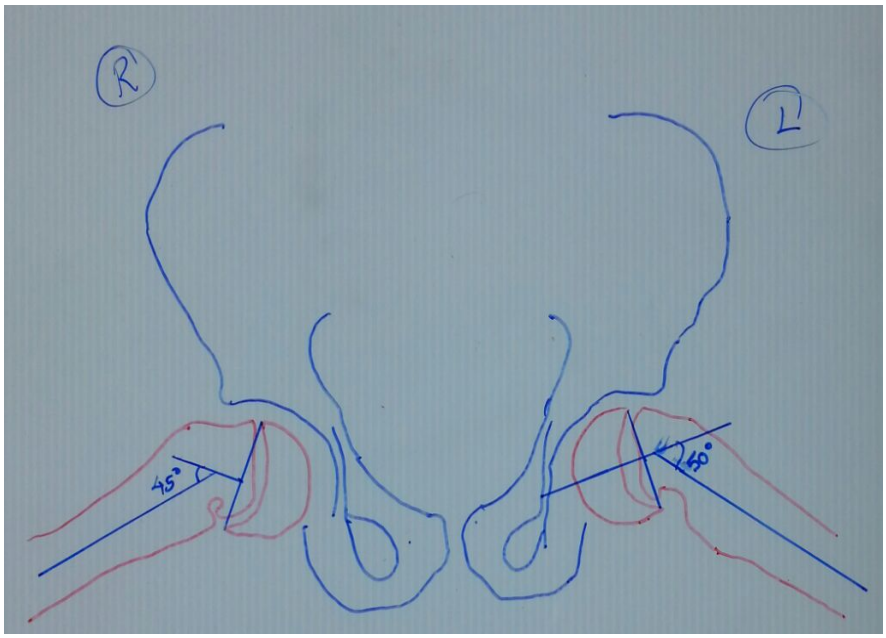


Case 2

A 14 years male with bilateral hip pain and limp for 6 months. This patient had fixed external rotation deformity of the left hip and restricted abduction , flexion on both sides. Radiological features were also suggestive of bilateral, chronic , stable SCFE.

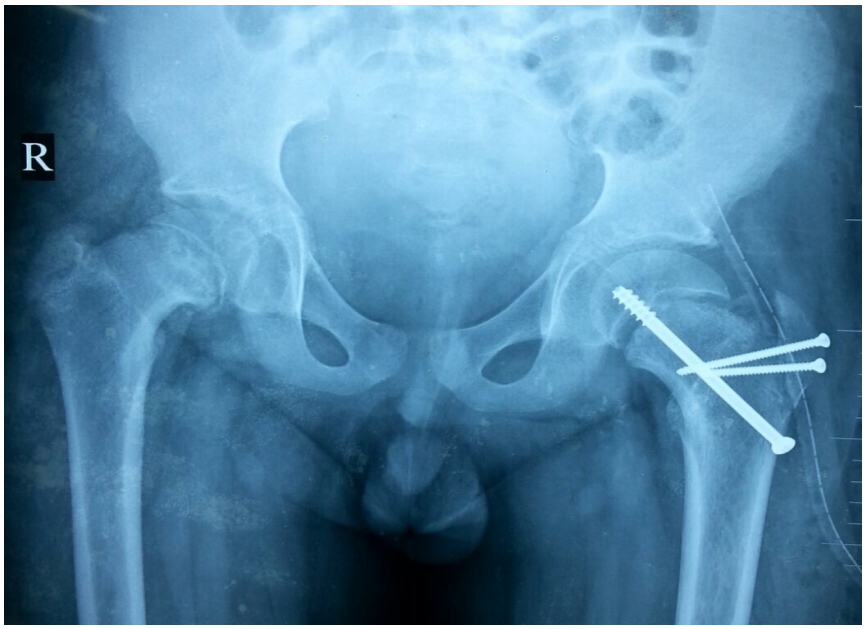
Anteroposterior radiograph

Frog-leg lateral view

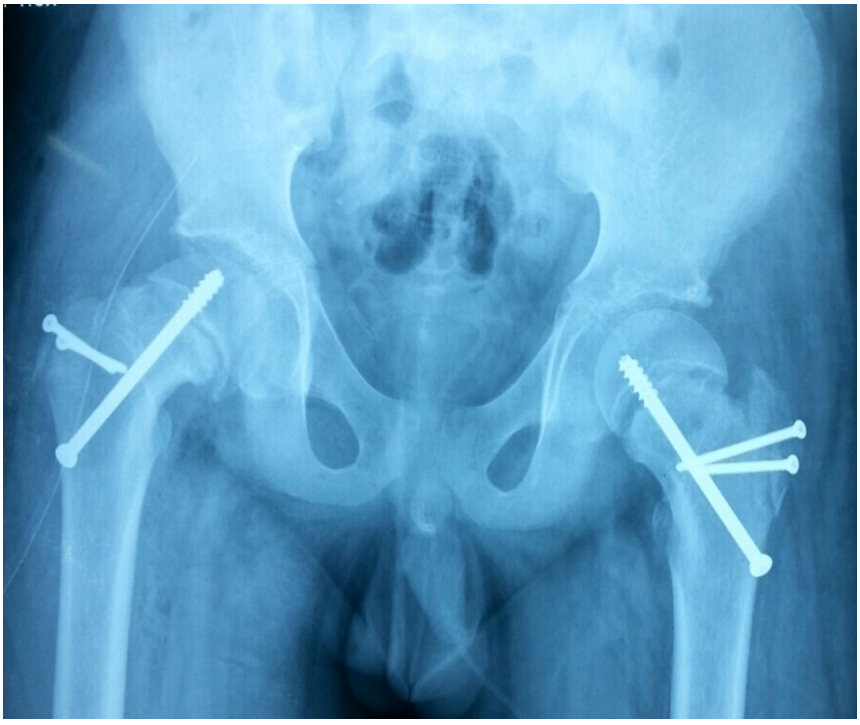


Immediate postop radiographs

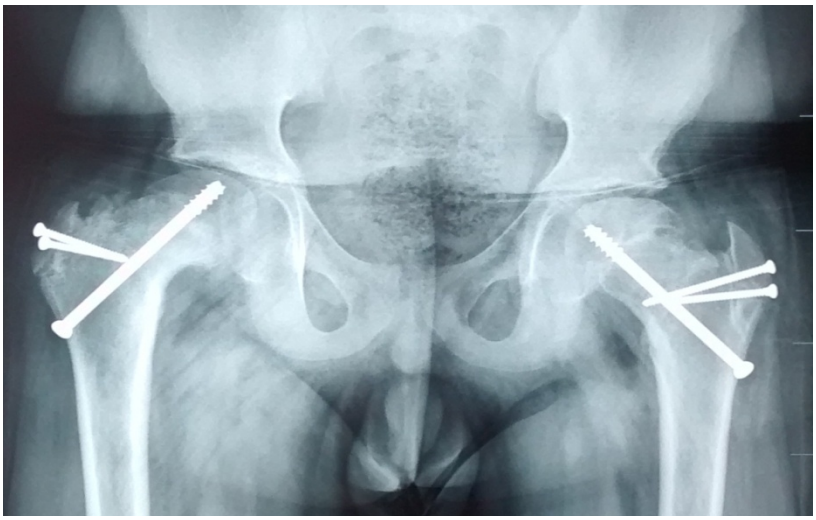
Left hip



Right hip



6 weeks follwup(right hip)

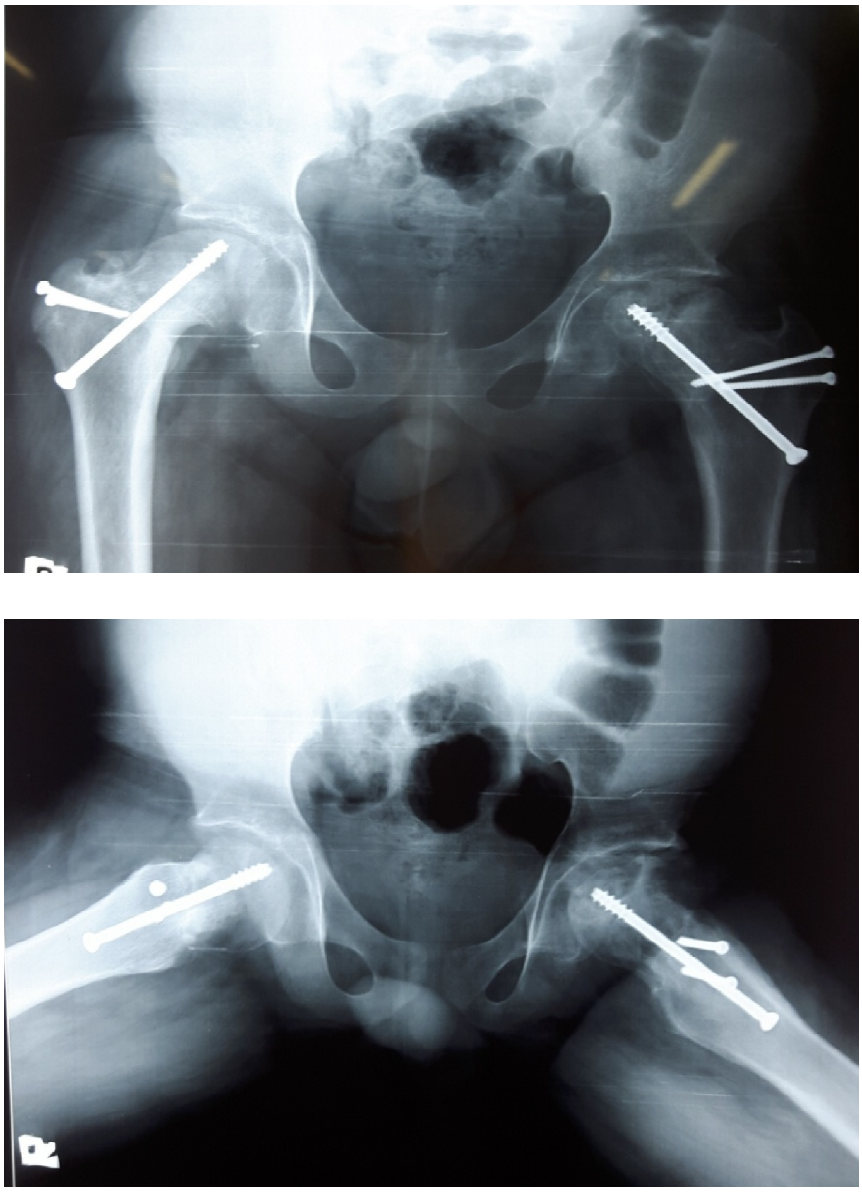


Postop abduction 60˚

Postop internal rotation 20˚

10 months postoperative radiograph

showing avascular necrosis in left hip



At 10 months postop this patient Xray showed avascular necrosis. But patient is clinically better except for a minimal limp. His HHS is fair -76

Case 3

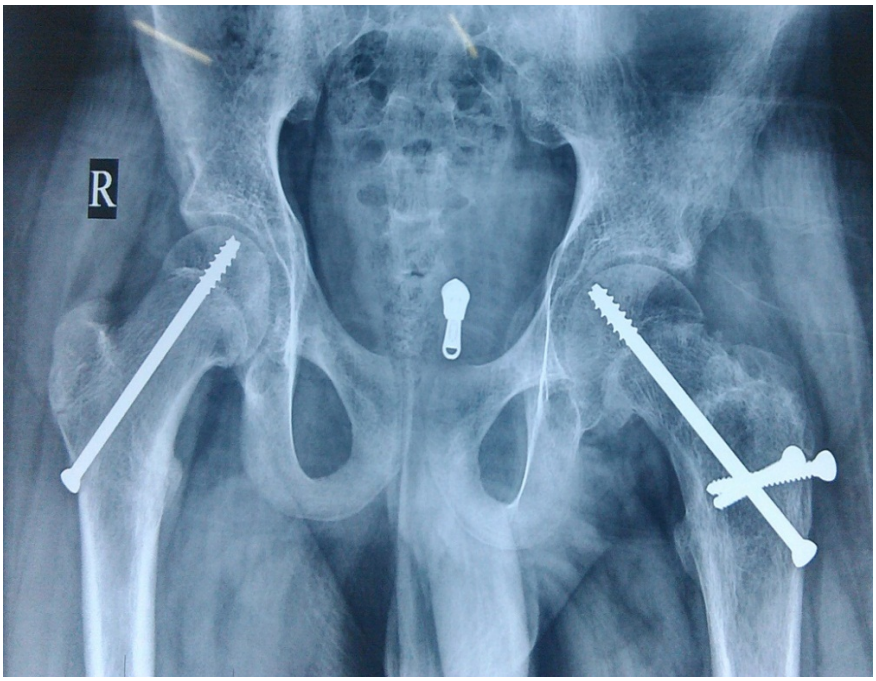
A 13 years male, with chronic bilateral SCFE (Left side – moderate slip, right side – mild slip)

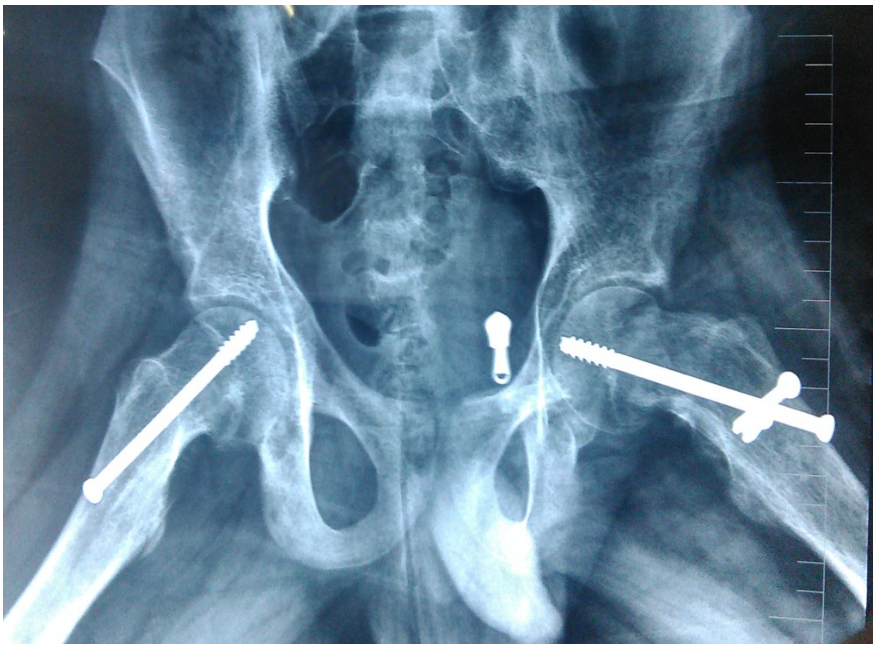
Subcapital realignment by safe surgical dislocation done on the left side.

Percutaneous insitu fixation done on right side in the same sitting.

Anteroposterior Radiograph

Postoperative radiographs





Case 4

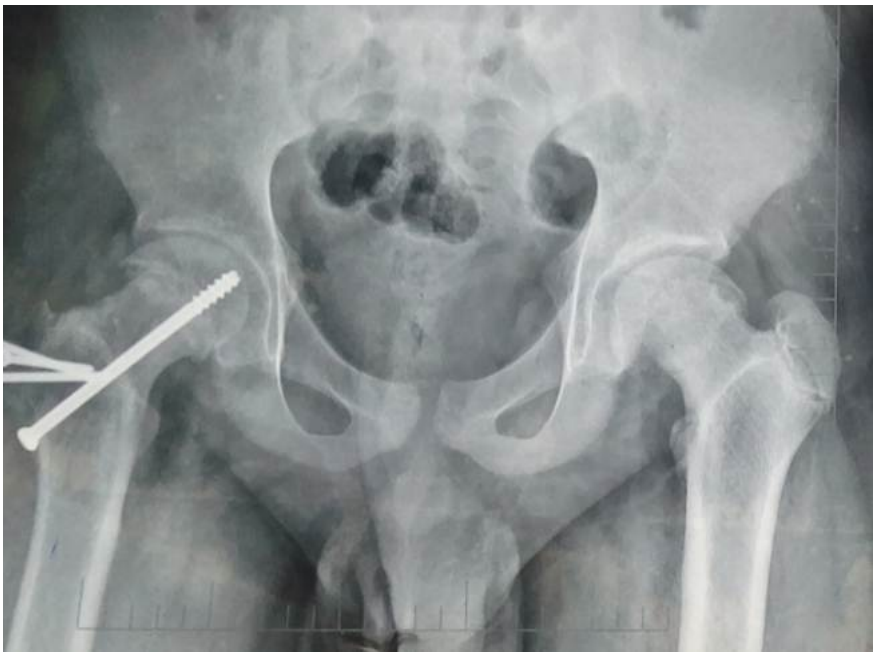
A 13 years male presented with bilateral SCFE.

Subcapital realignment done on right side initially. This patient is obese and investigated for endicrinological disorders but found to be negative.

After 10 months subcapital realignment done on left side.

Anteroposterior Radiograph

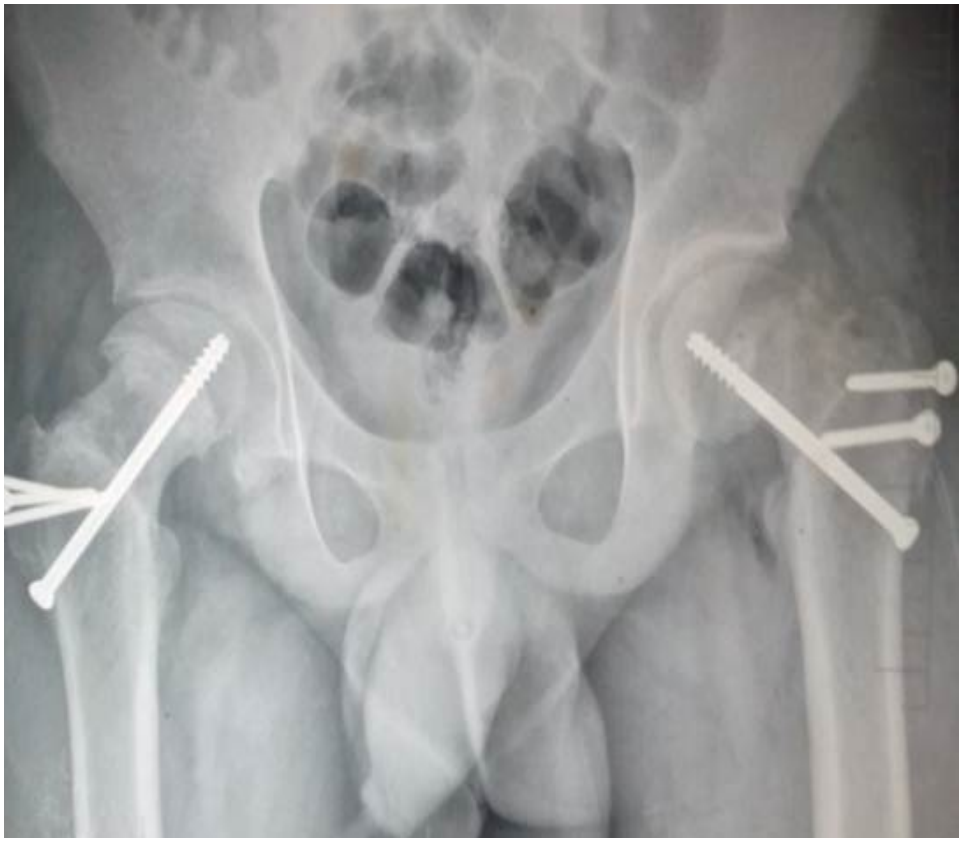
Postop radiograph right hip



Frog-leg lateral view

At 10 months interval

Postop left hip



Conclusion

Our study results support that a perfect anatomical reduction of the slipped physis can be achieved by safe surgical dislocation method. Complete correction of the slip angle is made possible by this technique. Subcapital realignment corrects the femoroacetabular impingement and minimizes the development of secondary arthritis thereby, increasing the longevity of the hip joint perse.

A perfectly done surgical procedure as described in our study makes vascular injury to the femoral head a very rare occurence.

To conclude, although this procedure is technically demanding , it is worth the effort and skill for a condition that could have lifelong consequences in an otherwise young and active population.

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Annexures

Patient Consent Form

Study Title: **"SLIPPED CAPITAL FEMORAL EPIPHYSIS TREATED BY SURGICAL HIP DISLOCATION AND SUBCAPITAL REALIGNMENT OF EPIPHYSIS –A SHORT TERM OUTCOME ANALYSIS".**

Study Center: Institute of Orthopaedics and traumatology, Rajiv Gandhi Govt. General Hospital, Madras Medical College, Chennai - 3.

Participant Name: Age/Sex: I.P.No. :

I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the pitfall in the procedure. I have been explained about the safety, advantage and disadvantage of the technique.

I understood that my participation in the study is voluntary and that I am free to withdraw at anytime without giving any reason.

I understand that investigation, regulatory authorities and the ethics committee will not need my permission to look at my health records both in respect to current study and any further research that may be conducted in relation to it, even if I withdraw from the study.

I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law.

I agree not to restrict the use of any data or results that arise from the study.

Date :

Place : **Signature / Thumb impression of Guardian**

Patient Name :

Signature of the investigator:

Name of the investigator: Dr.MuthuSubash.E.M.V

Proforma

Name

Age

Sex

IP Number

Date of admission :

Duration of illness:

Date of surgery:

Diagnosis:

Procedure done :

Passive Mobilisation started on:

Date of discharge:

1st follow up :

(6 weeks)

Trochanteric union:

2nd follow up:

(12 weeks)

Range of movements

3rd follow up:

(6 months)

Features of Avascular Necrosis

Harris Hip Score

Pain

- ☐ None or ignores it (44)
- ☐ Slight, occasional, no compromise in activities (40)
- ☐ Mild pain, no effect on average activities, rarely moderate pain with unusual activity; may take aspirin (30)
- ☐ Moderate pain, tolerable but makes concessions to pain; some limitation of ordinary activity or work; may require occasional pain medicine stronger than aspirin (20)
- ☐ Marked pain, serious limitation of activities (10)
- ☐ Totally disabled, crippled, pain in bed, bedridden (0)

Limp

- ☐ None (11)
- ☐ Slight (8)
- ☐ Moderate (5)
- ☐ Severe (0)

Support

- ☐ None (11)
- ☐ Cane for long walks (7)
- ☐ Cane most of the time (5)
- ☐ One crutch (3)
- ☐ Two canes (2)
- ☐ Two crutches (0)
- ☐ Not able to walk (0)

Distance Walked

- ☐ Unlimited (11)
- ☐ Six blocks (8)
- ☐ Two or three blocks (5)
- ☐ Indoors only (2)
- ☐ Bed and chair (0)

Stairs

- ☐ Normally without using a railing (4)
- ☐ Normally using a railing (2)
- ☐ In any manner (1)
- ☐ Unable to do stairs (0)

Put on Shoes and Socks

☐ With ease (4) ☐ With difficulty (2) ☐ Unable (0)

Sitting

- ☐ Comfortably in ordinary chair 1 hour (5)
- ☐ On a high chair for $^1/_2$ hour (3)
- ☐ Unable to sit comfortably in any chair (0)

Enter public transportation: ☐ Yes (1) ☐ No

Flexion contracture: _____ (degrees)

Leg-length discrepancy: _____ (cm)

Absence of Deformity (all Yes = 4; <4 = 0)

<30 degrees fixed flexion contracture:	☐ Yes	☐ No
<10 degrees fixed adduction:	☐ Yes	☐ No
<10 degrees fixed internal rotation in extension:	☐ Yes	☐ No
Limb-length discrepancy <3.2 cm:	☐ Yes	☐ No

Range of Motion (*Normal)

Total degree measurements, then check range to obtain score

Flexion (*140 degrees): _____	External rotation (*40 degrees): _____
Abduction (*40 degrees): _____	Internal rotation (*40 degrees): _____

Adduction (*40 degrees): _____

Range-of-Motion Scale

211-300 degrees (5)	61-100 degrees (2)
161-210 degrees (4)	31-60 degrees (1)
101-160 degrees (3)	0-30 degrees (0)

Range-of-Motion Score: _____

Total Harris Hip Score: _____

Readmission to Hospital: ☐ Yes ☐ No

Date of Readmission: ___/___/___

Implant Removal Date: ___/___/___

Comments: _____

_____

Investigator Signature: _____ **Date:** ___/___/___ (mm/dd/yy)

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI 600 003

EC Reg.No.ECR/270/Inst./TN/2013
Telephone No.044 25305301A
Fax: 011 25363970

CERTIFICATE OF APPROVAL

To
Dr.Muthu Subash.E.M.V.
Post Graduate in M.S. Orthopaedics
Institute of Orthopaedics and Traumatology
Madras Medical College
Chennai 600 003

Dear Dr.Muthu Subash.E.M.V.,

The Institutional Ethics Committee has considered your request and approved your study titled **"SLIPPED CAPITAL FEMORAL EPIPHYSIS TREATED BY SURGICAL HIP DISLOCATION AND SUBCAPITAL REALIGNMENT OF EPIPHYSIS – A SHORT TERM OUTCOME ANALYSIS' NO. 17082016.**

The following members of Ethics Committee were present in the meeting hold on **02.08.2016** conducted at Madras Medical College, Chennai 3

1.Dr.C.Rajendran, MD.,	:Chairperson
2.Dr.M.K.Muralidharan,MS.,M.Ch.,Dean, MMC,Ch-3	:Deputy Chairperson
3.Prof.Sudha Seshayyan,MD., Vice Principal,MMC,Ch-3	: Member Secretary
4.Prof.B.Vasanthi,MD., Prof.of Pharmacology.,MMC,Ch-3	: Member
5.Prof.P.Raghumani,MS, Prof. of Surgery,RGGGH,Ch-3	: Member
6.Prof.R.Padmavathy,MD,Director, Inst.of Path,MMC,Ch-3	: Member
7.Prof.S.Tito, MD, Director,Inst.of Int.Med.,MMC,Ch-3	: Member
8.Tmt.J.Rajalakshmi, JAO,MMC, Ch-3	: Lay Person
9.Thiru S.Govindasamy, BA.,BL,High Court,Chennai	: Lawyer
10.Tmt.Arnold Saulina, MA.,MSW.,	:Social Scientist

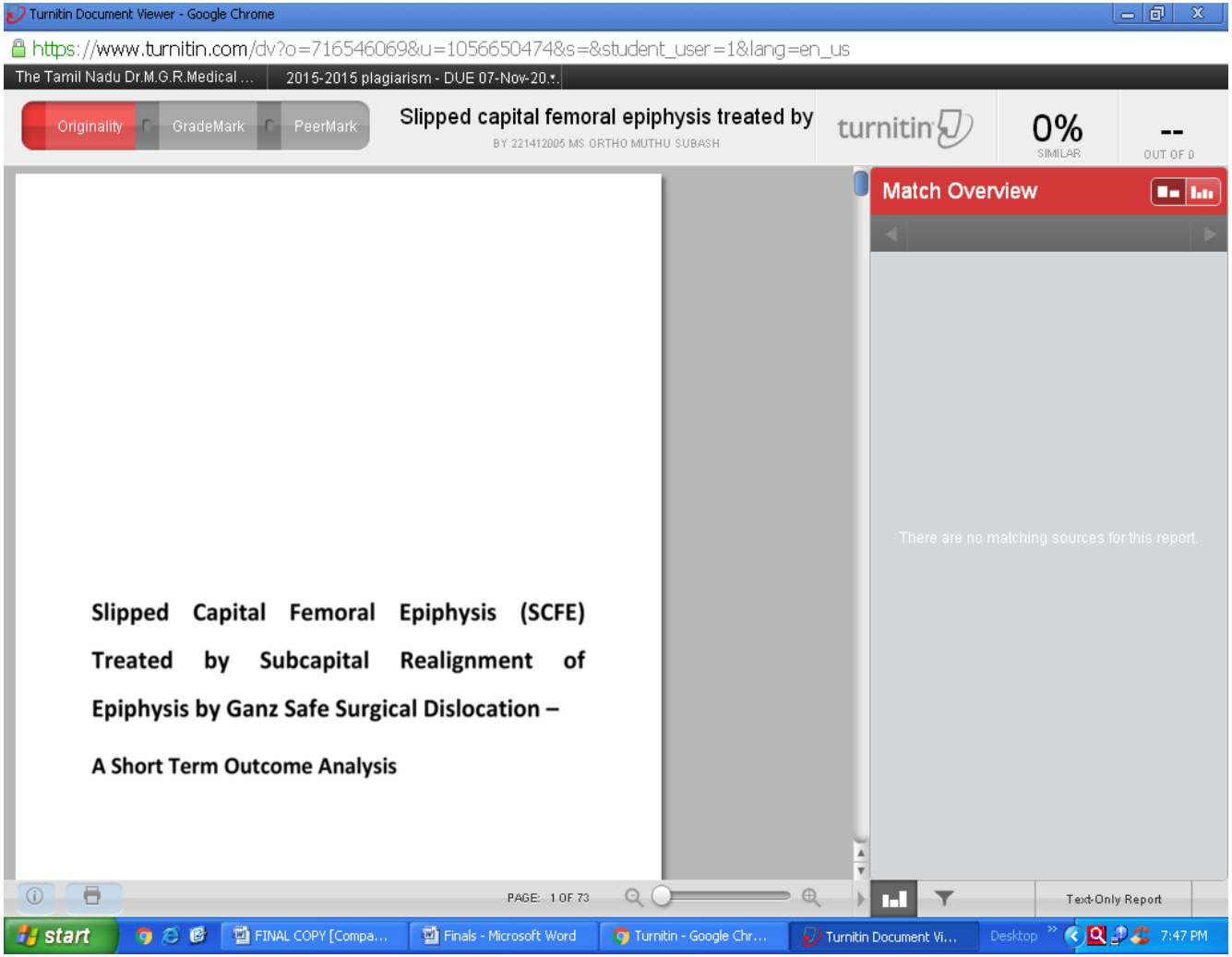
We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

2018

Member Secretary – Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003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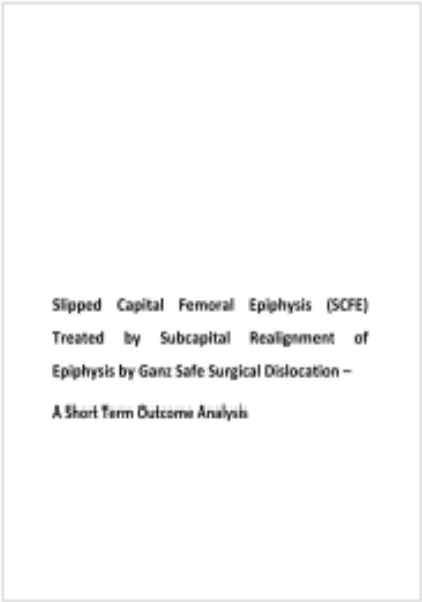

Slipped Capital Femoral Epiphysis (SCFE) Treated by Subcapital Realignment of Epiphysis by Ganz Safe Surgical Dislocation – A Short Term Outcome Analysis

Master Chart

S.No.	Patient Name IP No.	Age& Sex	Side	Obesity	Duration of illness (weeks)	South wick Slip Angle		Follow up (months)	Trochanteric union (weeks)	Complicat-ions	Outcome Harris Hip Score
						Pre-op	Post-op				
1	Mr.Naveen 83122	13/ male	Left	Yes	3	45˚	8˚	10	6	Nil	Excellent
2	Mr.Mohanraj 46784	13/ male	Right	No	4	40˚	12˚	10	6	Nil	Excellent
3	Mr.Nagaraj 55808	14/ male	Right	Yes	24	70˚	10˚	8	6	Nil	Excellent
4	Mr.Nagaraj 55808	14/ male	Left	No	40	45˚	12˚	7	7	Nil	Good
5	Mr.Jeeva 44705	14/ male	Right	Yes	12	40˚	8˚	15	6	Nil	Excellent
6	Mr.Jeeva 44705	14/ male	Left	No	36	45˚	15˚	16	7	Avascular Necrosis	Fair
7	Mr.Karthik 50109	15/ male	Left	No	3	50˚	10˚	8	8	Nil	Excellent
8	Mr.Pradeep 48783	13/ male	Right	No	8	40˚	12˚	10	7	Nil	Good
9	Mr.Nitish 53494	14/ male	Left	No	4	40˚	10˚	8	6	Nil	Good
10	Mr.Vijaykumar 51062	16/ male	Left	No	3	70˚	10˚	10	7	Nil	Excellent